



GB

Energy Efficiency

Optimisation for Web Offset Printers





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Selected bibliography and sources of information

“Clean Air Compliance Handbook”
MEGTEC Systems

“Environmental Considerations”
Web Offset Champion Group, 2005, www.wocg.info



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Optimising Energy Efficiency

There are three realities concerning energy:

- Supply is limited and it will remain expensive.
- The cheapest kW of energy is the one not used.
- Priority to reduce CO₂ emissions from fossil fuelled energy

Most experts predict high long-term prices due to rising energy demand and limited supply. There is a direct correlation between CO₂ fossil emissions and energy consumption. Improved energy efficiency is the fastest and cheapest way to reduce CO₂ because investment in available technologies would cut carbon emissions by about half of the amount needed to stabilise them.

The McKinsey Global Institute in 2007 concluded that investment in energy efficiency of about \$170 bn a year worldwide would yield a profit of about 17%. While energy efficiency has been improving at an average of 1.3% a year since 1980, there is significant global variation and best practices need to be adopted worldwide. Improved energy efficiency is the fastest and cheapest way to reduce GHG because investment in available technologies would cut carbon emissions by about half of the amount needed to stabilise GHG

Therefore, it is a priority to optimise the use of energy. Effective management of energy (electricity, gas, propane, diesel, petrol) reduces operating costs, improves working conditions and helps protect the environment. To achieve this requires a holistic and systematic. For these reasons PrintCity has initiated a cross-industry study on the subject to:

- Better understand energy linked context & correlations
- Identify how to reduce energy consumption & costs
- Identify related environmental benefits.
- Improve awareness of energy issue for management & staff

Increasing energy prices

Substantially higher prices for energy sources in the last three years have been driven by strong economic growth that has increased worldwide demand for raw materials (coal, crude oil and natural gas), low capacity of reserves, tense political situations and natural disasters. For example, in July 2006 the OPEC price for a barrel of crude oil reached a maximum of \$68. In April 2008 the costs for a barrel crude oil was over \$110. Most experts predict higher prices over the long term due to rising energy demand and limited supply. Industrial gas and electricity costs are strongly influenced by oil prices. There are significant national differences in European energy costs both for electricity and gas — therefore, the economic viability of some technologies can vary significantly.

Carbon and energy reduction — 20/20/20%

An additional driver is the proposed European environmental targets to be achieved by 2020 as a follow-on to Kyoto:

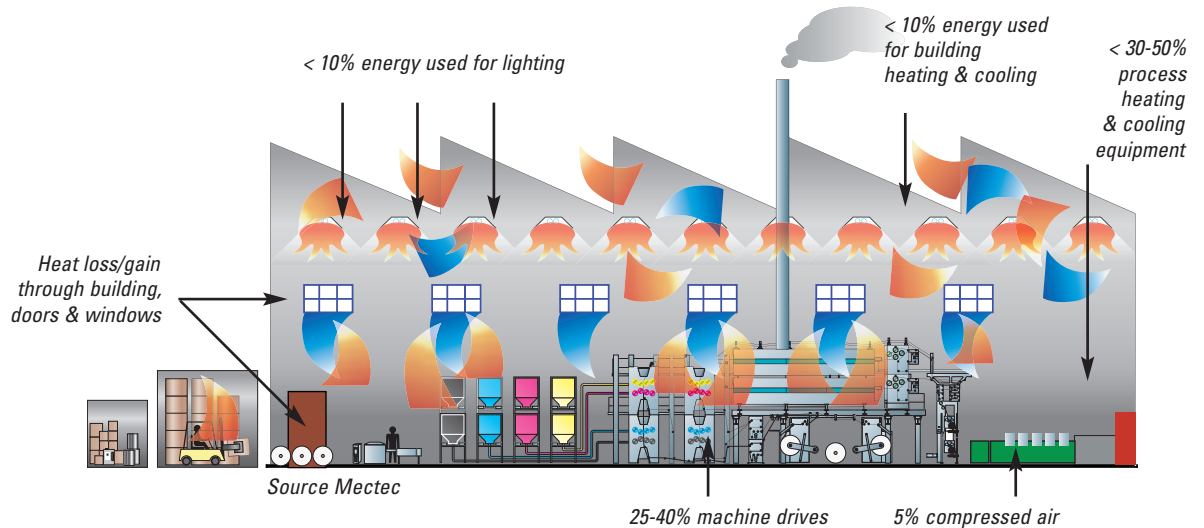
- 20% less emissions
- 20% improvement in energy efficiency
- 20% of energy from renewable resources.

Whilst these targets are not yet finalised, it is almost certain that industry will face further challenges in this area. The reduction of carbon footprint is a major energy related issue. On the other hand, it is expected that governments will offer taxation and other incentives. This should mean that the amortisation of energy efficient technologies will be reduced, and inefficient ones penalised, and it suggests that companies should identify a long-term energy strategy when considering any new investment in equipment and buildings.

Developing a company energy management strategy is a key to success. Energy companies, government and industry associations can provide advice.

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Improving Energy Efficiency



Production process consumes 70-80% of energy. Source: Web Offset Champion Group "Environmental Considerations".

The primary sources of energy consumption in a printing plant include:

- Building & services
- Internal transport
- Production equipment.

Buildings & services

Building energy consumption is around half to one third of what is used for production; however, the potential savings are often more readily available in this area from:

1. Eliminating excessive consumption from over-heating, lighting areas not in use, air leaks and draughts.
2. Maintaining desired conditions (temperature, humidity, light) by monitoring or control – the use of computerised control of heating, ventilation, air conditioning and other support systems.
3. Annual costs are very high for printing plants operating 24 hours/day and this is often the best place to start an energy management programme. New lighting technologies can save up to 50% of energy, provide 50% more light, and give an ROI in around 2 years.
4. Improving energy efficiency of buildings. Key elements that effect building energy efficiency are
 - Construction materials and their insulation properties; position of doors, windows and ventilation; external window shading; space heating/cooling; hot water supply; lighting.
 - Efficient summer ventilation - even in temperate countries - can be more important than space heating due to excessive heat build-up from the equipment used.
 - Design and layout can have a major impact on energy use, materials transport and physical workflow.
 - Unloading doors are a significant source of air leaks and draughts, particularly if there are doors at opposite ends of the building. This can be reduced by: partitioning the loading bay; using plastic strip curtains; heated air curtains and seals in the loading bay. Push button door operation encourages employees to close doors. Fit self-closing doors at external exits and between departments. In some cases install windbreaks around external doors.

For new buildings, include solar and natural efficiencies, correct orientation to sun and prevailing winds, and use of energy efficient materials. Existing building efficiency can often be improved to generate good return on investment.

Internal transport

Review physical workflows to minimise distances travelled and introduce best practice procedures.

Effective maintenance programmes for roll and fork lift truck units will significantly lower their energy consumption and running costs.

Variable costs of electricity and gas

There are significant national differences in European energy costs that are also different for electricity and gas. Some countries also pay companies a significantly higher kW purchase rate when they sell electricity back to the grid. So-called 'green' electricity generation can attract a further premium. This means that companies need to analyse these costs carefully beforehand to establish amortisation of an investment that concerns energy

Develop an energy management strategy

Source: WOCG « Environmental Considerations »

If the answers to the following three questions are 'NO' then you may want to consider implementing an energy management strategy:

- Does the site have an energy efficiency programme with a person responsible for it?
- Is the site's energy consumption known and regularly reviewed?
- Is the site as energy efficient as possible?

The first step to implement an energy management strategy is to create a suitable company team. There are many sources of free energy expertise — government bodies, utilities and industry associations. Consultants may be useful to help make an initial energy audit and advise on a management programme.

Best practice to manage energy

1. Key Energy Performance Indicators (KEPIs): How much energy is used, where and why? Analyse invoices for the last 12 months for each energy source and establish their total energy costs. Create a common energy measurement unit by converting each energy type into kilowatt hours (kWh). Compare monthly data and check tariffs. Avoid variations by reading meters yourself because they are rarely read on the same day each month. Calculate the base energy load during months when there is no heating or air conditioning consumption. Lighting consumption can be estimated by multiplying installed kW load by the hours in use. Estimate the load by the number of fittings and their power rating (conventional fluorescent lighting is typically 10-20 W/m²). It may be useful to separate production and office areas if they use different types of lighting.

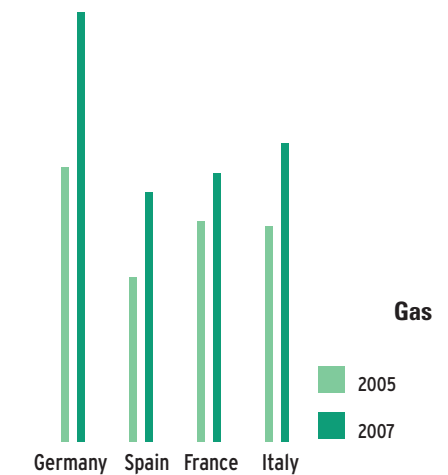
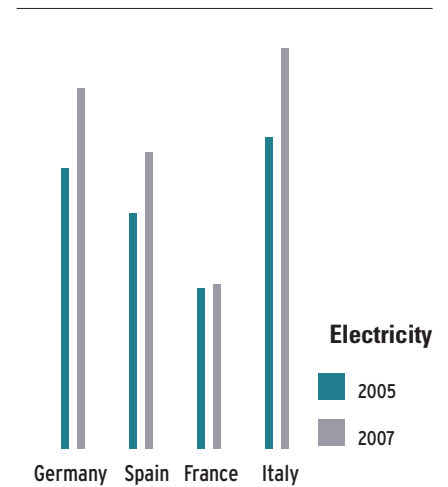
2. Compare data: Use graphics to present data in a format that allows analysis of energy per m²/ft², energy per tonne of production, energy per tonne of raw materials (paper and ink), energy per unit of turnover, energy per employee.

3. What are the potential savings: Production-related, or buildings/general services, or lighting? Rank the most important potential savings area and concentrate on one to demonstrate success before moving to another.

4. How to achieve savings: Set targets, monitor results, give feedback, ask for ideas. Most people are willing to help if they understand the problem. Motivate staff to share ownership of tasks and solutions and recognise their success. Assess investments that provide good ROI from energy savings.

5. Housekeeping: The cumulative cost of small incidences of wasted energy is significant. Train and motivate staff to use better working practices: switch off computers, printers, copiers and lights when not in use; close doors; consider installing occupancy sensors to automatically control lighting and equipment.

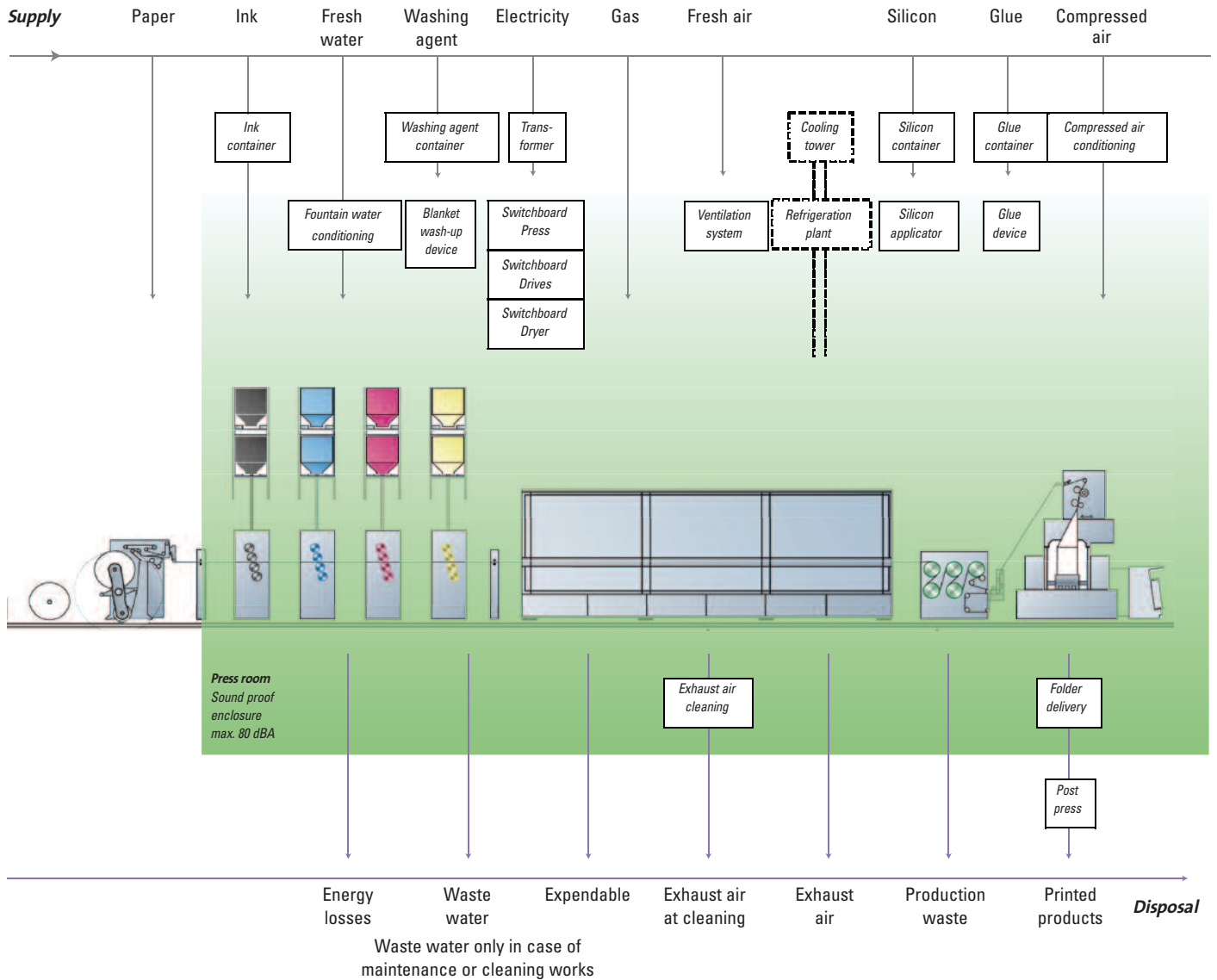
6. Energy purchase costs: Are you paying the best rate for energy? Verify with your supplier(s)



These tables show the evolution of electricity and gas prices in different European countries between 2005-2007.

Source: Eurostat.

Improving Process Energy Efficiency



Printing production system energy consumption is a complex relationship of press components, consumables and operating practices.

The many opportunities to improve energy efficiency throughout the press system include:

1. Press drives
2. Blankets
3. Rollers
4. Dryer-oxidizer
5. Evaporative process cooling
6. Ventilating press enclosures
7. Compressors
8. Systematic maintenance and correct settings.
9. Operating procedures
10. Paper selection and ink coverage

A specialist engineering member of the PrintCity Alliance project team — Duschl Ingenieure — takes a holistic approach to energy efficient industrial plant design and operation. Their experience demonstrates that each production process, machine and person produces heat — in many cases climate control is needed to maintain a temperature and humidity range. This means that there are multiple relationships of total energy used in any given environment.

For example, a chiller working temperature of 6°C – 12°C on the cold side requires compressors and the multiplier relation between the excess heat and the electrical energy used for chilling is about 35%. Replacing the chiller with a cooling tower can considerably reduce this. In many cases it is possible to use water-cooled motors, or to extract heat from airflows with temperatures above 40°C. If so, the multiplier relation between the excess of heat and the energy used for cooling will be around 10% or less.

Optimisation of system components

An analysis of the whole process is important to optimise the energy consumption of the machines, components and the ambient climate. The complete analysis of all factors opens a window of possibilities to optimise the temperature, humidity and energy relationships.

The optimal set-up of the components of a system can improve overall efficiency and lower total costs. This includes exactly planned service intervals for all equipment, optimised planning of the operations, use of control systems for ventilation and air-conditioning systems, simplified air ducts, low air speed, accessible air-filter chambers, extremely low pressure losses, optimised lifecycle of filter elements, correct pipe work for compressed air, low pressure losses, optimised lifecycles of filter elements, etc.

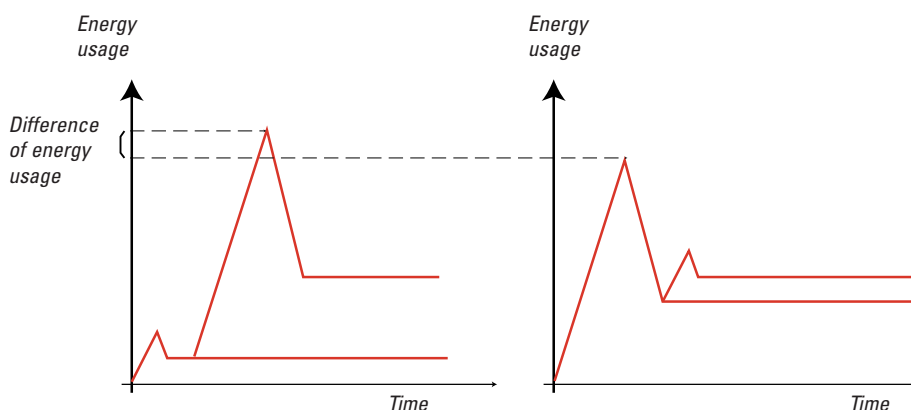
Regular preventive maintenance has an impact on energy consumption. It is essential to ensure correct settings and lubrication, and that air filters are not blocked.

Sources of heat build-up

When a press starts up, the web's motion creates large and rapid air movement, which quickly changes humidity and temperature. If the replacement air is too cool it can create local cold spots and operating problems. Heat is generated by the press, its electronic equipment (and dryer if fitted), and this can be lost through windows and the roof and walls of the building. The difference between summer and winter internal temperatures can be up to 20°C and poor ventilation can add another 20°C. Optimum printing conditions may only be obtained in some locations by factory-wide climate control.

Machine start-up management

The simultaneous start-up of high performance machines leads to a high peak of energy consumption in a short period of time. For this reason it is more efficient to start high performance machines first and then progressively switch on other machines to reduce energy peaks.



It is more efficient to start high performance machines first and then progressively switch-on other machines to reduce energy peaks.

Source Duschl Engineers.

Optimising New Press Installation Energy Efficiency

There are usually three energy technology options when specifying a press line:

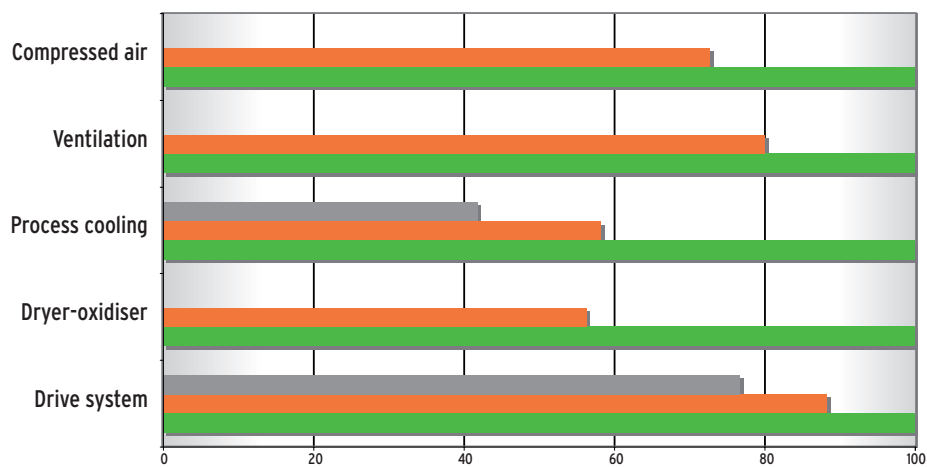
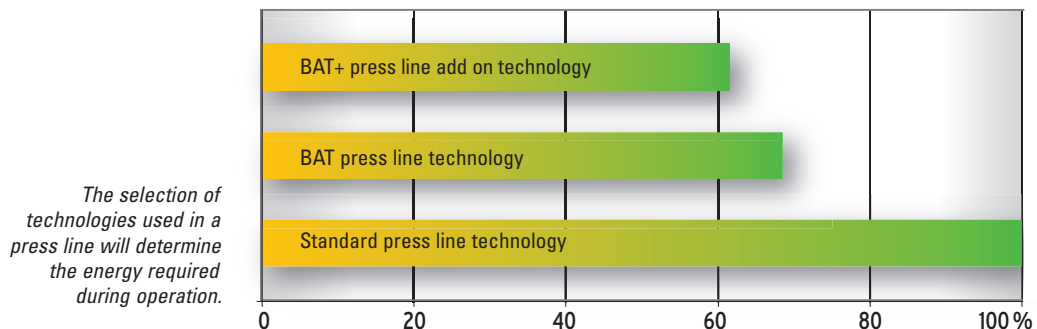
- **Standard technologies:** Usually the lowest investment cost and the highest energy consumption.
- **Best Available Technologies:** Generally have higher investment but lower running costs.
- **BAT + systems:** Have the minimum energy consumption. Some, like process cooling and drives, can be integrated into the press line. Others allow secondary reuse of waste process energy.

Their economic viability depends on the local costs of energy, and heat recovery also depends on the geographic position of the company, the building's energy efficiency, and the heat radiation of installed equipment.

Prior to an investment decision, it is highly recommended to make a comparative assessment of the technology alternatives and their economic viability over the total lifecycle of the press.

Installed power?

The amount of installed power for a piece of equipment is frequently much higher than what it actually needs during most of its lifetime. One of the reasons is that extra power is required during the running-in period in order to overcome mechanical resistance. However, this can be reduced if the printer agrees to run less than maximum speed for the first about 3 months. The numbers have to be calculated for each press and configuration.

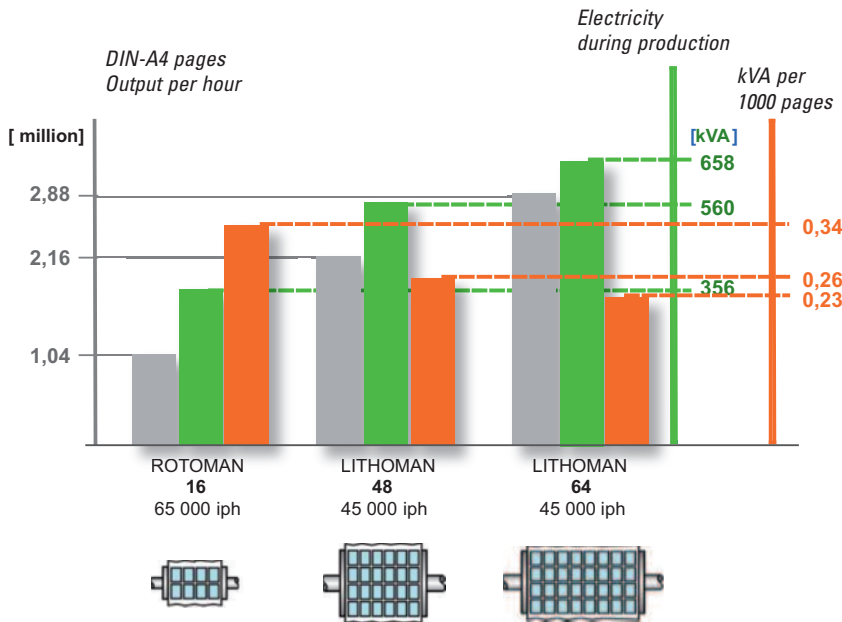


This energy chart is an example of energy consumption of the main system components for a 72-page heatset press.

- Standard press line technology
- BAT press energy technology
- BAT + technology

Press size?

New investment is the ideal opportunity to assess the optimum press format size in relation to the work being produced. In the past 10 years there has been a significant trend to larger format size of 48, 64 and 80 pages to reduce total cost of printing. One of these economies is to reduce power consumption per page.



Larger press formats reduce the energy required to print a page. Source manroland.

Supplementary systems to reuse waste thermal energy (see pages 16-17)

Significant process thermal energy is lost from the dryer-oxidizer exhaust emission. This 'free' waste thermal energy can be used in one of three ways.

This example shows the waste energy that can be recovered from a 72-page heatset press operating 6000 hours a year with an energy consumption of 500 kW. There is a choice between electricity generation of 80kW, heat recovery with a maximum power of 480 kW or absorber technology with 230 kW chilling capacity and 560 kW warm water. The economic viability depends on the local costs of energy, the geographic position of the company, the building's energy efficiency, and the heat radiation of installed equipment. Process water can also be pre-heated.

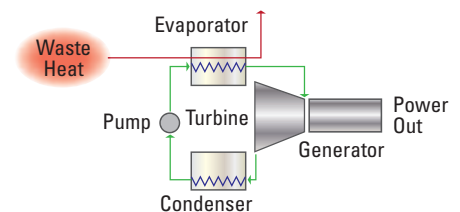
As an example, a printing factory in Germany (using air conditioning with an internal heat recovery efficiency of 70 %) and equipped with two heatset presses has a heat demand of

Offices	1.600 m ²	transmission	80 kW
	10.000 m ³	Ventilation heat requirement	60 kW
Factory	2.300 m ²	transmission	120 kW
	11.500 m ³	Ventilation heat requirement	270 kW
		Radiation of the machines	- 240 kW
			290 kW

The total heat demand for the offices and factory is 800 MWh/a. The absorber process of one press running time of 18 h per day produces heat of about 3564 MWh/a. The free heat from a large press is enough to heat the entire building. The radiation heat of the printing machines is enough to heat the factory.

Electricity generation

The economic viability of electricity using an Organic Rankine Cycle Process (ORC) depends on the local costs of energy for internal use and, in some countries, the often higher value per kW to sell back to the power grid. This means that in Germany the amortisation is around four years, while in the UK it would be over eight years.



The Organic Rankine Cycle Process (ORC) converts waste exhaust heat into electricity. Source Duschl Ingenieure.

Blankets & Rollers



Offset Printing Blankets compressibility test.
Photo Trelleborg.

The impact of blankets on energy consumption

The blanket can play an important role to minimise energy in the printing unit, in some cases by up to 20%. Until recently, blankets were required to reliably give good printing quality and ink transfer and attain the right dot gain with a good paper release after impression. However, these characteristics on their own are no longer adequate for shaftless presses and wider web widths. Blanket performance must now minimise energy in the printing unit and avoid overheating. Blanket features that influence energy consumption are:

- Carcass design (fabrics, compressible layer, top)
- Compressibility (which load value)
- Top face rubber compound (polarity)
- Surface finishing (roughness)

In practical terms, the blanket should maintain the temperature of the cylinders during printing to within a certain range and within a power absorption range defined by the press manufacturer. This can be achieved by designing blankets with different dynamic and feeding characteristics. The blanket supplier must evaluate the most suitable product for each specific new press installation and then test it to ensure that its characteristics satisfy the needs of the press.

An example of a blanket that minimises power consumption of the printing units and heat generated during printing is metal back blanket (MBB) technology used on shaftless newspaper presses.

Blanket feeding can significantly impact energy consumption on all web offset presses. Each type of blanket has its own paper feed characteristic that plays an extremely important role in web tension control. This is mainly influenced by the blanket's construction, top rubber compound characteristic, surface finishing and compressibility. By simply changing the blanket construction, it is possible to obtain a blanket with a positive or negative paper feed. There are many blankets available with very different paper feed characteristics and the printer needs to select the most suitable one.

What is a positive or negative feed blanket?

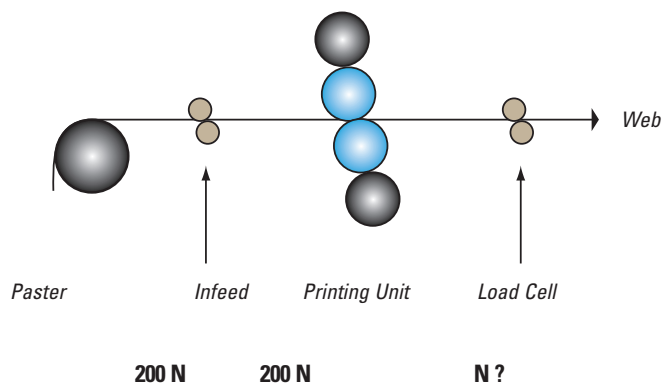
Positive feed blankets tend to 'give more paper' and the tension after the printing unit will decrease compared to the infeed because the web tends to follow the leading blanket cylinder — the web will flutter due to this loss of tension. In this case, all tension points on the press have to be perfectly adjusted — the infeed unit must give less paper to the printing units and more tension to the chill rolls and folder.

Negative feed blankets have a higher paper tension than the infeed — the web will go to the next printing unit correctly tight. However, if the blanket paper feed is too high there is not enough correction margin at tension points on the press. Working at maximum tension increases the risk of web breaks, particularly during splicing.

- Example of positive feeding: Splicer: 200 N / Infeed: 220 N / Load cell: 170 N or < than infeed unit
- Example of negative feeding: Splicer: 200 N / Infeed: 220 N / Load cell: 220 N or > than infeed unit

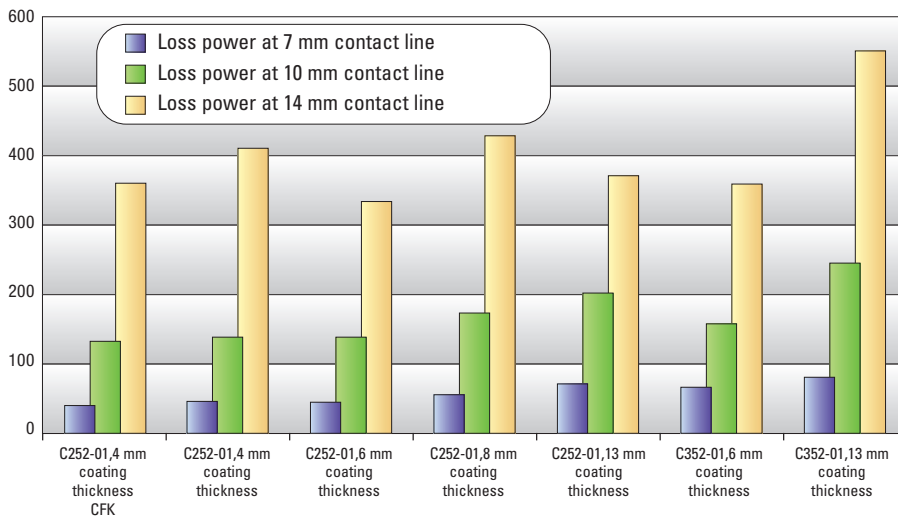
Environment sustainability also includes the materials and process to produce the blankets. This includes selecting technologies to eliminate or drastically reduce the quantity of solvent used during production because this lowers solvent recovery power consumption by 50%.

The schematic shows an infeed and a single printing unit followed by a load cell to measure paper tension. All tension values after the infeed (slitter, RTF and nips) are expressed in gain % compared to the speed of the printing unit's drive motor. To evaluate different blankets they need to use the same ink and paper for all trials. The paster and infeed value is maintained as a constant by only changing the blanket. The paper tension (measured in Newtons 'N') after the printing unit then shows the paper feed behaviour of different blankets.
Source Trelleborg.



Printing rollers

The heat build up from rubber rollers depends on the specific loss factor of the rubber material, the deformation speed, number of nips per revolution, adjustment of the roller nips and the thickness of the rubber layer. Heat build up of a roller is limited by decreasing the loss factor in dependence of the increasing temperature and heat transfer to the press environment. There are also temperature related quality risks to avoid such as blistering and cracking if temperatures are too high, or smearing if too low.



This chart shows the energy loss from heat build up of ink rollers. Source Westland.

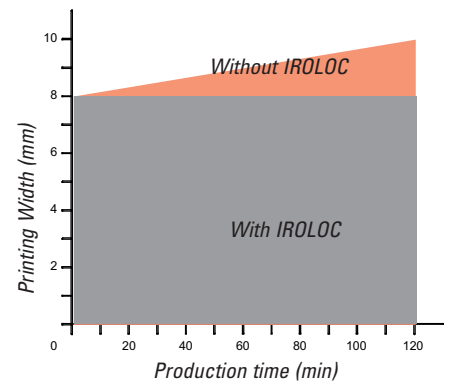
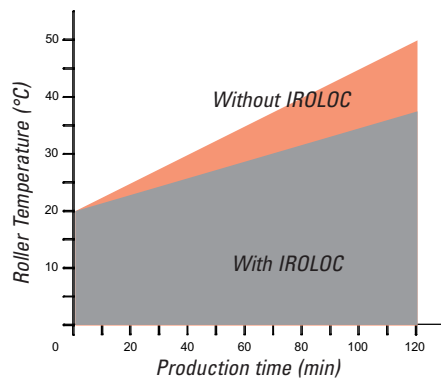
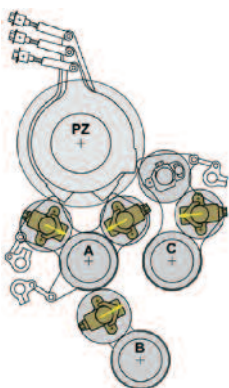
'Intelligent' transfer and forme rollers

A self-adjusting roller lock-up system automatically and dynamically adjusts the roller nips to significantly save energy. The system also ensures high and consistent print quality; reduces roller maintenance cost by 65%; and extends the lifetime of rollers by up to 20%.

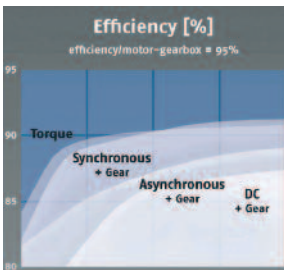
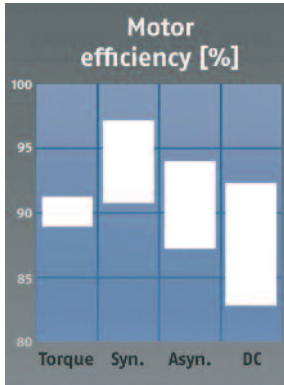
Paper guide rollers in the folder superstructure

The energy required to transport webs and ribbons from the turner bars to the folder formers can be minimised by using smooth running paper guide rollers (that are lifetime lubricated) with low mass inertia in a graduated arrangement.

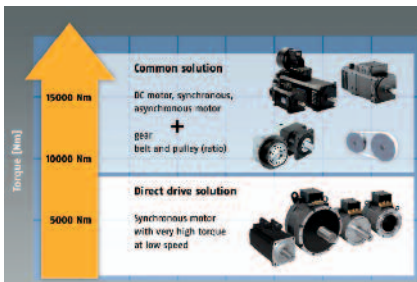
The IROLOC automatic roller lock-up system saves energy. Illustrations manroland.



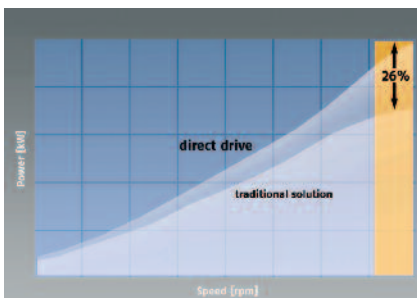
Press & Drive Efficiency



Comparative efficiency of different drives and motors. Source: Baumüller



Direct drives eliminate mechanical drive transmission and reduce energy required by 20-50%. Source: Baumüller

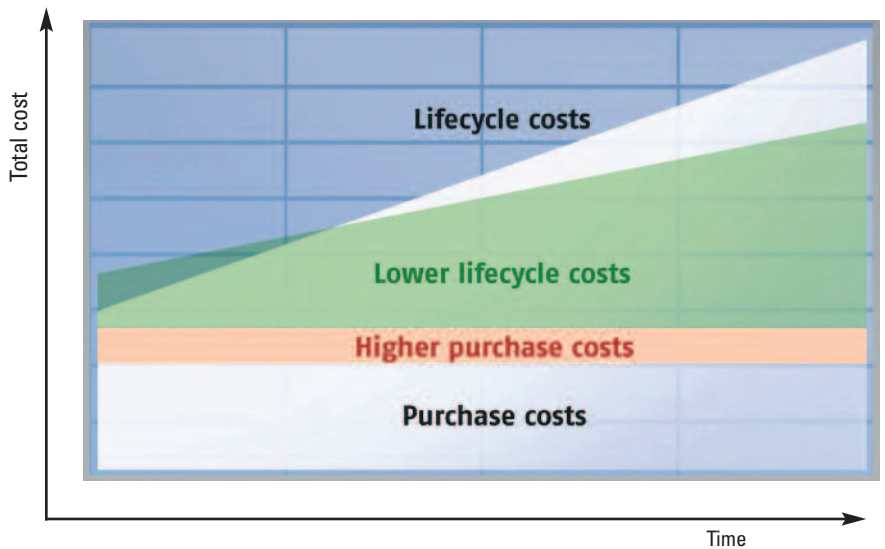


Direct drives are more efficient than motor-gear combinations. Source: Baumüller.

A growing awareness of the environment and the rising cost of electricity explain the increasing popularity of energy efficient drive systems for industrial applications. In 2005, the EU Commission issued a framework directive (EuP) to ensure more efficient energy usage to reduce CO₂ emissions to counter the greenhouse gas effect.

Lifecycle costs

Energy costs can account for up to 90% of lifecycle operational expenses and are the primary driver for electric drive development. The high energy efficiency of direct drives typically allows their higher cost to be recovered after just a few years and sometimes even months. Potential for energy efficiency and associated cost savings can only be fully exploited by adopting system-wide approach. To ensure optimum energy usage, motors have to be precisely sized and operated at the ideal power/space ratio. This avoids the problem of excess energy usage and reduces the physical space required.



Lifecycle operational expenses and are the primary driver on electric drive development Source: Baumüller

Motors

Direct drives provide increased efficiency by eliminating the need for gears or belts for mechanical drive transmission purposes — this reduces the power loss from 22 - 9 % to about 4.5%. This means that a nominal 100 kW drive operating 6,000 hours a year requires 54,000-112,000 kWh for with a conventional drive concept but only 27,000 kWh for direct drive concept. At 0.08 € / K kWh this yields annual savings of 2,880 - 7,120 €. Synchronous motors combine high torques with low speeds. Water cooled motors and frequency converters allow the waste heat dissipation to be reused for low temperature processes. The significantly reduced running noise often makes expensive noise suppression obsolete.

Converters

Converters that feed energy back into the power system during the braking portion of the machine cycle have been available for over 20 years. The energy generated is recycled through a regenerative power system instead of being dumped as waste heat. A machine with approximately 50 kW regenerative and braking power operating 6,000 hours a year at 0.08 € / K kWh provides annual savings of approximately 21,000 €.

Ink & Paper

Ink and its supply

The optimum size of ink supply systems with fewer bends and short pipework will minimise power required for pumping. Using bulk or larger supply containers for ink, dampening solution and silicone will reduce logistics energy and costs, require less handling, and the supplier can share responsibility of better stock control.

Ink on paper

The amount of ink required to achieve the target print densities has an impact on energy used in printing and ink demand is primarily related to the type of paper. The chart compares the paper with the lowest ink consumption (MWC-WFC) for the print density of D1.50. The Improved Newsprint (INP) has a 67% higher ink consumption, SC 33% and LWC 8%. LWC requires about 23% less ink than SC. SC papers have high moisture content and require more energy for heatset drying than LWC.

Paper and ink influences on energy consumption

Paper selection and parameters influence printing energy consumption. This table shows the differences in energy between a 'standard' and an 'add on' paper that has lower energy consumption for a 48-page heatset press. In most cases, "add on" papers that minimise energy use in drying have a lower print quality. However, in some cases the decrease in drying temperature can compensate for some of the loss in print quality.

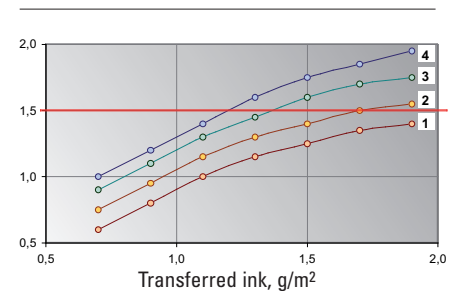
Paper properties effecting energy consumption in heatset printing

Paper impact on energy use	Paper properties	"Add on" changes in paper properties	Typical magnitude of change	Average savings with "add on"
Drives and web path	Basis weight	Lower basis weight	- 20%	22% but only about 10 Wh per printed roll
	Bulk	Higher bulk	+ 25%	
	Porosity, B:sen	Higher porosity	+ 60%	
	Roughness, PPS	Higher roughness	+ 55%	
	Friction	Lower friction	- 30%	
	Tensile stiffness	Higher tensile stiffness	+ 25%	
Printing nips, web release from blankets	Ink setting	Slower ink setting	- 15%	18%
	Ink demand	Lower ink demand	- 20%	
	Porosity	Higher porosity	+ 60%	
Drying and cooling	Roughness	Higher roughness	+ 55%	40 kWh per printing nip
	Moisture content	Lower moisture cont.	- 35%	
	Ash content	Higher ash content	+ 30%	
	Ink demand	Lower ink demand	- 20%	
	Grammage	Lower paper weight?*	- 20%	
	Porosity	Higher porosity?***	+ 40%	
	Roughness	Lower roughness	- 40%	
Coated/Uncoated	Coated paper	Coated	24% savings in total energy for drying and cooling***	

* Lower weight without higher ink demand

** Higher porosity without higher ink demand

*** See pages 12-13 for the impact of dryers with integrated oxidisers.



- 1 - Improved Newsprint (INP)
- 2 - Super Calendered (SC)
- 3 - Light Weight Coated (LWC)
- 4 - Medium Weight Coated Wood Free Coated (MWC, WFC)

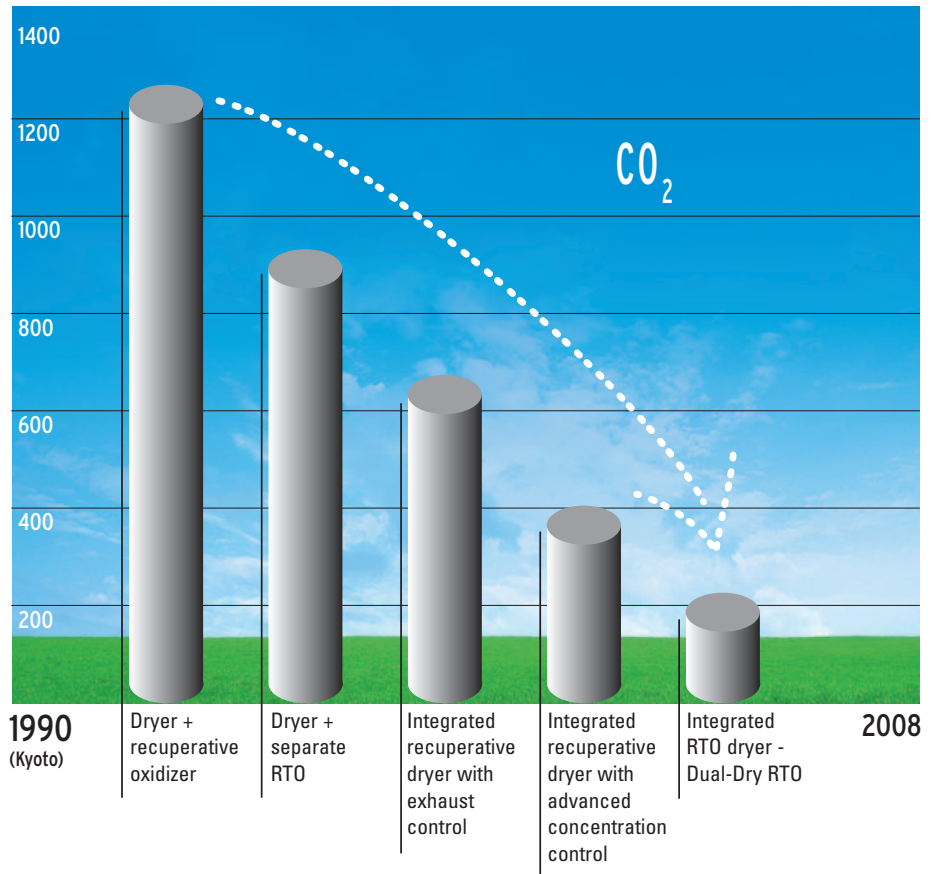
Typical ink demands measured for cyan with different types of papers. Source UPM



Using bulk or larger supply containers for ink reduce logistics energy and costs. Photo Sun Chemical.

Drying and Air Pollution Control

Comparative kW gas consumption and related CO₂ emission of dryer oxidizer combinations and the technical development from 1990 until today. Source: MEGTEC



Heatset Dryer-Oxidizer

Continuously rising energy prices and more stringent environmental requirements in combination with wider and faster webs demand different technology for profitable operation of high volume offset heatset presses.

The system configuration (independent or integrated oxidizer) and oxidizing technology have a significant impact on potential energy savings:

- **50-70% energy saving in the oxidizer** can be achieved by replacing off-line recuperative oxidizers with off-line Regenerative Thermal Oxidation (RTO).
 - **50% energy saving by replacing independent recuperative oxidizers with integrated recuperative dryer-oxidizers.** The integrated dryer-oxidizer is a closed-loop operation that recycles the energy contained in ink solvents during the drying process and transfers it to the oxidizer as energy for oxidation. The heat generated from oxidation is then transferred back to the dryer to reduce its gas consumption.
 - **Integrated RTO dryer-oxidizers give the highest energy savings possible** (95% heat exchange efficiency v 65% for recuperative). In many production conditions the unit requires no additional energy because it is self-sustaining using only the energy from the process solvents.
- Other energy considerations when selecting dryer-oxidizers includes the thermal efficiency and electrical consumption of the air bar system, use of frequency controlled process fans, exhaust reduction system, and low exhaust flow rate in stand-by. Most dryers-oxidizers can be fitted with secondary heat exchangers for energy recovery to produce warm or hot water. See also page 16.

Regenerative Thermal Oxidation (RTO)

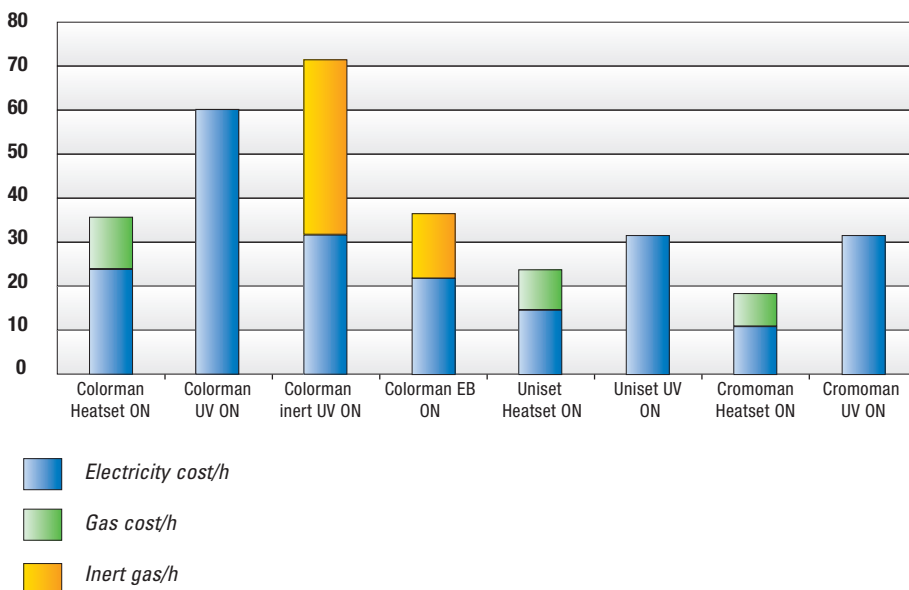
The integration of RTO oxidation for air pollution compliance combined with an ultra high 95% efficiency heat exchanger is the most fuel-efficient dryer available. Under many production conditions, the RTO supplies all the energy required for both, oxidation and drying, leading to zero fuel consumption. In average production conditions, the RTO reduces gas consumption by 50% compared to the best performing recuperative systems with advanced concentration control. The RTO technology burns ink solvent at a combustion temperature about 100°C above the temperature required by recuperative systems. The result is a guaranteed 50% reduction of NO_x and CO₂ emissions without negative impact on the lifetime of the oxidizer. CO₂ emissions are reduced under all printing conditions to make the Dual-Dry® RTO the most environmentally friendly dryer available.

Optimised drying

Optimised drying of paper reduces cost and improves quality because each paper has its own 'drying window'. Paper with a low internal strength will reduce the window, whilst high internal strength increases it. There are also temperature related quality risks to avoid such as blistering and cracking if temperatures are too high, or smearing if too low. Different types of paper have different drying requirements and the temperature zones in the dryer need to be adjusted accordingly. Another influence is optimised prepress to minimise ink laydown combined with densitomer or closed loop colour control to prevent over inking.

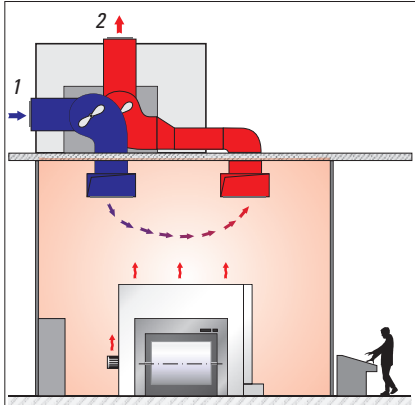
Other drying technologies for web offset?

Heatset drying remains the most economic and energy efficient process for most commercial web offset applications. This is validated by the PrintCity VAPoN (Value Added Printing of Newspapers) project team's exacting economic modelling of the comparative differences of the capital and operating costs of all drying and curing processes. The energy costs for each drying process are calculated as part of the operating costs. Heatset dryers have the highest capital investment but deliver the lowest total production cost and have the lowest total energy needs. Electron Beam (EB) has the next lowest total energy cost, followed by Inert UV and Conventional UV. However, newspaper process choice — unlike commercial printing — is not simply determined by lowest total running cost. Their criteria can also include the frequency of use of a dryer, available capital and space to install a dryer on an existing press that can favour UV. EB use is currently confined to packaging.



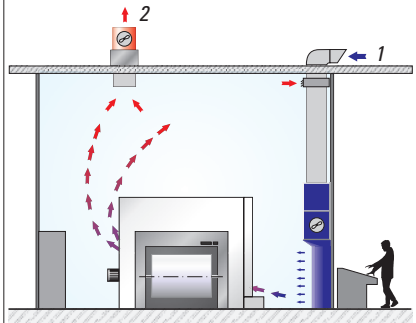
Comparative energy costs for different drying and curing systems. Source PrintCity VAPoN.

Process Cooling & Ventilation



The supply air (1) entering the press sound enclosure takes a short and ineffective route to the exhaust (2).
Source Axima.

The supply air (1) enters the press enclosure at ground level and is the natural thermal air flow travels upwards to the exhaust point (2).
Source Axima.



Process cooling

A chilled water system for each press is generally more energy efficient than a large chilling plant for multiple presses because these do not work efficiently under partial load. Precise control of water circuit temperatures is essential to control energy use and avoid negative effects on runability and quality. Two types of technologies are available for cold water production:

Air and water cooled compressor chillers

These have a higher primary energy draw than water cooled types because of the changing temperatures in the condenser. The use of split systems — with separate condenser units — risks energy loss from the high volume of refrigerant liquid.

Closed cooling tower

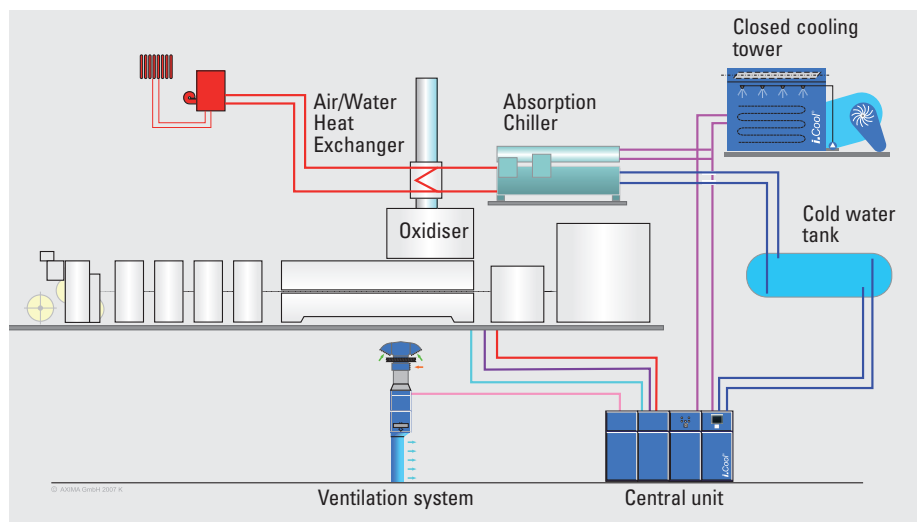
Energy savings of up to 70% are available from a closed evaporative cooling tower combined with a water cooled refrigeration unit managed by PLC control to automatically maintain precise temperatures in all circuits. Temperature stabiliser units for the oscillating ink rollers, ink fountain rollers and blanket cylinders can be bought to preset temperatures before the press starts and the temperature then adjusts to web speed. These systems provide: more reliable operating conditions to give longer component life from reduced switching; independent refrigerating circuits; reduced wear on moving parts (constant temperature conditions in a closed, dirt-free refrigeration circuit); and back-up from independent chill water generators. A coldwater storage tank allows constant and optimal efficiency. The automatic routing of cold water for the chill rolls through an outdoor chilling unit when the external temperature drops below 10°C can considerably reduce energy draw and has an ROI of less than one year.

Ventilating press enclosures

Heat is generated by the press line and through the building. The difference between summer and winter internal temperatures can be up to 20°C and poor ventilation can add another 20°C.

When a press starts up, the web's motion creates a large and rapid air movement that quickly changes the humidity and temperature. If the replacement air is too cool it can create local cold spots and operating problems.

A fully integrated press cooling system with a closed cooling tower offers very high energy efficiency.
Source Axima.



Soundproofing: A quiet working environment leads to increased efficiency and quality whilst ensuring compliance with the law. Noise and its consequences for health are major problems in working environments. Liability and health insurance records show the negative effects of excessive noise exposure in workshops and offices. Attention is needed to the design, construction and installation of hermetic sound enclosures to minimise energy consumption and optimise runability. Effective wall and ceiling connections minimise uncontrolled loss of energy within the enclosure, along with sealed incoming and outgoing lines to improve energy efficiency. Regulation systems may be used for heat recovery in winter.

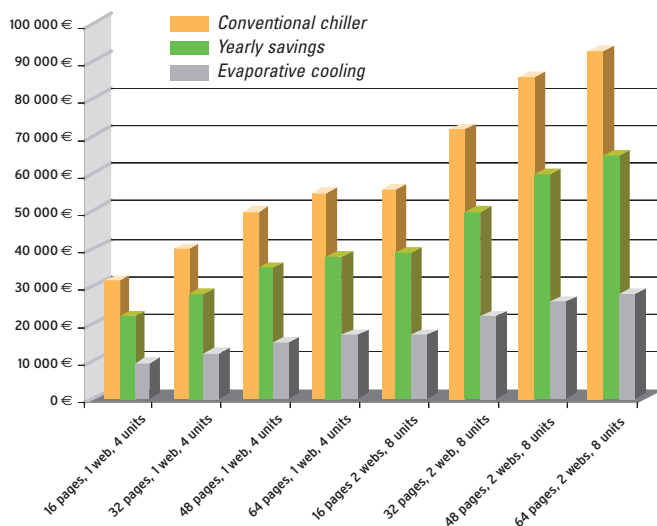


Air Compressors

About 70% of electricity consumed by a compressor is turned into heat. Compressors should be sized for the required load and pressure, as under-capacity utilisation is inefficient. An optimised system design can often reduce energy by about 30% from centralised air generation; on-demand sequence control can save 5-20%. Typically 30% of energy is lost from air leaks, which requires increased pressure to compensate for the leaks — an additional 10 psi increases power demand by 5-7% — therefore, systematic maintenance is important.

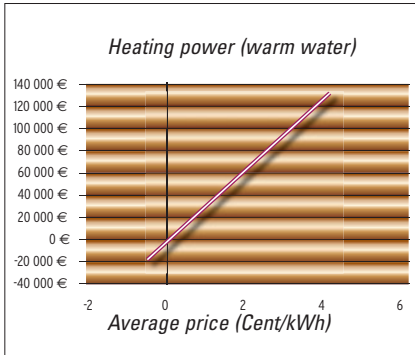
Correctly installed hermetic soundproofing reduces noise level below 80 dB(A) to not only ensure employees' health but also helps minimise energy loss. Source Faist.

On a heatset press, the temperature around the yellow unit next to the dryer is up to 15°C higher than the comparatively open first unit. However, the printing unit temperature of an enclosed press can be 10-20°C higher than an open line. Therefore soundproof booths should be equipped with a balanced air control system to ensure minimum energy consumption with optimised printing conditions. Constant temperature conditions for machines and processing also reduces down time and improves quality.



The comparative operating costs of different process cooling technologies. Source Axima

Reusing Waste Thermal Energy



The viability to reuse 3360 MWh/a from warm water for heating depends on the variable cost of energy in different countries. In the worst case, heating costs becomes negative if additional energy is needed to exhaust excessive heat, or to use air-conditioning. Source Duschl Ingenieure.

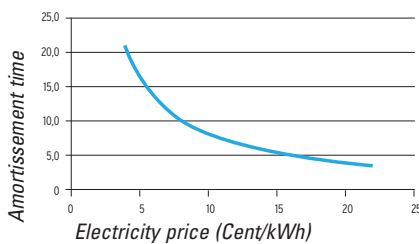
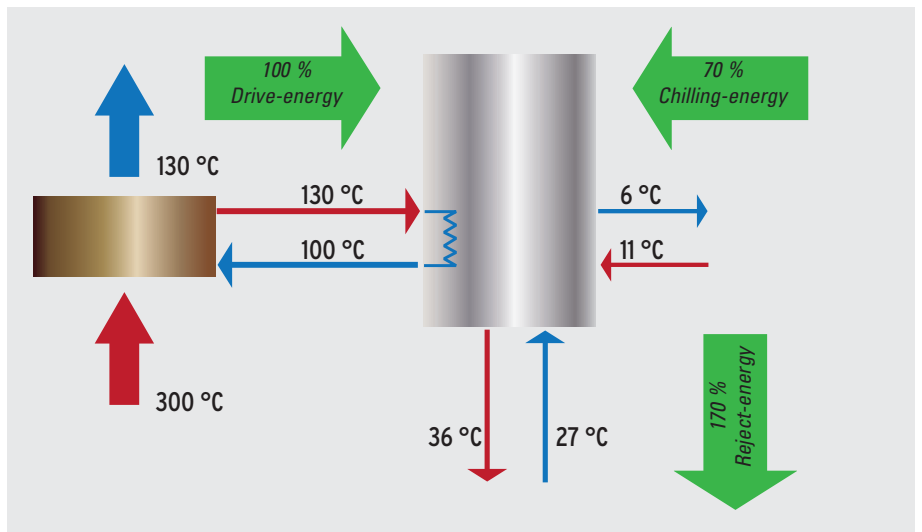
Significant process thermal energy is lost from the dryer-oxidizer exhaust emission. This 'free' waste thermal energy can be used in one of three ways. However, their economic viability depends on the local costs of energy. In addition, heat recovery (1 & 2) also depends on the geographic position of the company, the construction and energy efficiency of its building, and the heat radiation of installed equipment. While demand for warm water reuse in tropical countries is zero, the 3300 MWh/a is useable in cold climates for factory heating — or to sell to a district heating network, swimming pool, or for drying agricultural products like fruits or corn. To demonstrate this, the ROI of add-on technologies are calculated in three countries (Germany, UK, Malaysia) for a 72-page heatset press line operating for 6000 hours a year.

Consumption of the press	500 kW	
Useful waste power for heating	560 kW	1) Absorber water temperature 36 °C, or
	480 kW	2) Heat exchanger air flow with 300 °C.

1: Absorption technology to recycle waste heat

Absorption uses waste thermal energy from the dryer-oxidizer exhaust to cool the chilled water of the press. The typical exhaust emission is around 7000 m³/h at 300 °C that can produce 330 kW of energy. The chilling system requires an entry temperature of 11 °C and exits at 6 °C. The relation of heating to cooling power is 0,7, which means that the chilling power required is about 230 kW. For secondary utilisation, the relation to heating power is 1,7 for reject heat. Therefore, the potential yield is around 560 kW.

Typical energy flows in an absorber driven by the dryer-oxidizer exhaust. Source Duschl Ingenieure.



Amortisation time of an ORC investment depends on the local electricity costs. Source Duschl Ingenieure.

Economic example: The chilling demand of a 72-page heatset press is about 550 kW, of which about 40% can be supplied by the absorption process. The specific energy consumption of the absorber is four times higher than a traditional compressor arrangement. This means that the price for 1 kWh of heat energy cannot be higher than 25% of the electrical energy cost. The investment cost for 230 kW chilling power of an absorber system is 276 000 € 400% higher than a compressor system at 69 000 €. The electrical demand of the absorber is 4 kW (24 MWh/a) 10% of the compressor at 77 kW (462 MWh/a). The delivered value is 3 – 4 cent/kWh of warm water from 560 kW waste heating power.

	Electricity tariff	Annual electricity costs	Amortisation time
Germany	0,100 € /kWh	43.800 €	4,7 years
UK	0,095 € /kWh	41.600 €	5,0 years
Malaysia	0,0416 € /kWh	18.200 €	11,4 years

It is also possible to reuse again the low temperature (36 °C) residual waste heat for heating purposes in cold climates, which will further reduce the amortisation time.

2: Heat recovery using a heating exchanger

A plate heat exchanger or a circular flow system can recover waste heat from the drying process by cooling down the exhaust air from 300 °C to around 50°C to recover about 480 kW of thermal energy. Glass tube heat exchangers are particularly suitable for emission gases from the dryer-oxidiser exhaust. The recovered energy can be used to preheat the external air for factory and office heating.

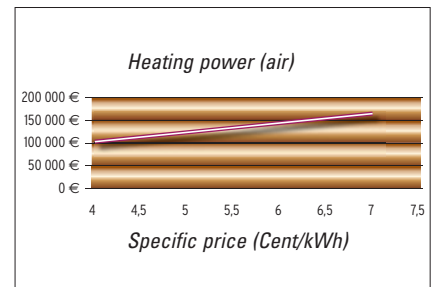
A 72-page press can make available 2880 MWh/a of heating power. The economic viability depends on the power required to heat air conditioning and ventilation systems, the annual number of heating hours required for the plant, and local cost of energy.

3: Free electricity generation

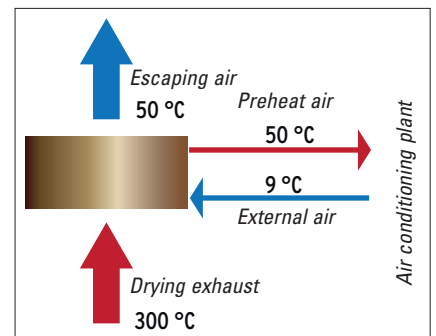
The Organic Rankine Cycle Process (ORC) converts waste heat from the dryers into electricity. The optimal use of the 320 °C emission waste heat requires an organic medium with a high specific vapour pressure to produce steam to run an electricity generator. The electricity can be either used for internal energy consumption or sold into the power grid. Amortisation is strongly related to the cost of local electricity supply and the price that electricity can be sold back to the grid.

The ORC produces about 80 kW electricity from the 600 kW heating waste of a 72-page heatset press. The investment is 5000 €/kW. Therefore 80 kW costs 400 000 € and if operated 6000/year generates 480 000 kWh.

	Germany	Great Britain	Malaysia
Electricity for internal use	10 cent/kWh	9,5 cent/kWh	4,1 cent/kWh
	48 000 €	45 600 €	20 000 €
Amortisation time	8,3 years	8,7 years	20,3 years
Electricity sold to power grid	20 cent/kWh	—	—
	96 000 €		
Amortisation time	4,16 years		



The effective reuse of hot air is similar to warm water — variable by location and operating conditions and local energy tariffs. Source Duschl Ingenieure.



Typical heat exchanger thermal energy flows. Source Duschl Ingenieure.



MEMBER

www.axima.de

Axima GmbH subsidiary Freiburg (formerly Sulzer Infra Baden) is the world's leading supplier of systems for the economical and ecological cooling and air-conditioning of presses and printing companies. For 25 years the company has delivered technical innovations that are state-of-the-art technology. Its systems are dedicated to the printing process and are always individually developed for web offset, newspaper, sheetfed and digital printing. Axima GmbH's broad range of services includes complete building technology with energy management, building process control techniques and general technical contracting.



MEMBER

www.baumueller.de

Baumüller is a leading automation partner to the printing industry, from sheet feed, to job and label printing, continuing through to newspaper printing. For decades, Baumüller has been collaborating with printing press manufacturers to develop and produce automation concepts and drive solutions. Thanks to the quality of Baumüller solutions, the company supplies innovative and complete drive systems to printing press manufacturers all over the world, providing a single source for all automation needs. Baumüller designs customized concepts and will meet and exceed the needs of the printing press throughout its entire life cycle.



PROJECT PARTICIPANT

www.duschl.de

DUSCHL INGENIEURE was founded in 1971 and is active Electrical and Mechanical Engineering, Conveyor Techniques, Process Control, Facility and Building Management, Technology Management and Consulting. Duschl designs feature strict economic efficiency that includes life cycle assessment, with particular attention to energy saving and use of renewable resources within an integrated and comprehensive solution. Economic designs, correctly managed and implemented on schedule have established the foundation for business with clients in industry, governmental, businesses and services. The company has 35 graduate engineers, 17 technicians and 16 other staff members employed at the main office in Rosenheim and branches in Munich, Erlangen, Frankfurt/Main, Chemnitz and Meran, Italy.



MEMBER

www.faist.de

FAIST Anlagenbau GmbH are the world's leading manufacturer of noise control solutions to the printing industry. A flexible construction system provides turnkey soundproofing that guarantees excellent noise reduction characteristics and all other relevant aspects such as accessibility, transparency, ventilation, lighting and custom design. A wide variety of solutions cover all needs for web systems to create high comfort levels in the workplace – including the economic factor that FAIST sets as a milestone in designing its systems. FAIST Anlagenbau has nearly 240 employees worldwide, with a turnover of approx. € 33 million in 2007.



MEMBER

www.manroland.com

manroland's sheetfed and web presses deliver unrivalled environmental performance. In 2000, the Augsburg plant joined the Bavarian environmental pact and participated in the Ökoprofit project of the city Augsburg in 2003. manroland then committed themselves to set up an environmental management system. All production centres are certified for ISO 9001 quality management while Augsburg and Plauen also comply with ISO 14001. The Offenbach and Mainhausen plants received the 2007 Glanzlicht-Auszeichnung award from the Ministry of the Environment in the German state of Hesse. This recognised improvements since 2001 to reduce energy by 30%, natural gas by 38% and water by 32%. Teams of specialists have optimised environmentally relevant production processes, and the company has invested in energy efficient equipment and buildings.



MEMBER

www.megtec.com

MEGTEC Systems is the world's largest supplier of webline and environmental technologies for web offset printing. The company is a specialised system supplier for roll and web handling (loading systems, pasters, infeeds) and web drying and conditioning (hot air dryers, oxidisers, chill rolls). MEGTEC combines these technologies with in depth process knowledge and experience in coldset and heatset printing. MEGTEC has manufacturing and R&D facilities in the US, France, Sweden and Germany, China and India along with regional sales, service and parts centres. MEGTEC also provides energy and efficiency consulting and machine upgrades.



MEMBER

www.sunchemical.com

The world's foremost producer of inks, pigments and colour technology, **Sun Chemical** is leading our industry in developing and producing products which minimise our impact - and our customers' impact - on the environment and is striving to maximise the use of renewable resources. We consider it our responsibility to be involved in the communities in which we live and work and to offer direction in meeting today's needs without compromising the ability of future generations to meet theirs. Sun Chemical offers products and services today that can help you conserve energy, lower emissions and reduce waste. However, the route to sustainability is a journey and we continue to invest in Research and Development to develop future ink, pigment and coating solutions that meet the needs of the present but also consider the needs of our future generations.



MEMBER

www.trelleborg.com/vulcan

Trelleborg Printing Blankets (formerly Reeves) is a product area within Trelleborg Engineered Systems. The Trelleborg Group is a world industrial leader in advanced polymer technology for high performance solutions to seal, damp and protect in demanding environments. Over 50 years printing industry experience — more than any other blanket producer — is combined with innovative technology, patented processes, vertical integration and total quality management. Servicing 60 countries on five continents, the Vulcan® brand is one of the world's leader in offset printing blankets for web, sheetfed, newspaper, digital, and packaging applications.



MEMBER

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UPM is a leading forest product company and paper manufacturer. The professionalism of our worldwide production and sales writes the story of our high quality papers every day, offering multiple inspiring paper platforms for various end uses. The environmental quality of UPM's papers is nurtured throughout the life cycle of the product—from a tiny seedling to the recycling of the used product. Continuous improvement is at the core of our operation. We use wood raw material and energy efficiently, prefer renewable energy sources, force emissions down as far as possible and use recycled materials to make new products. All UPM employees follow this philosophy in their daily work to accomplish proper practice of sustainable business. Certifying and monitoring proves that UPM's papers are made with sustainable fibre, fresh or recycled, low emissions and low carbon footprint.