



GREENHOUSE GAS EMISSION FACTORS FOR OFFICE COPY PAPER

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INTRODUCTION

This paper outlines the background and justification for office paper emission factors used by EPA Victoria. It provides emission factors that demonstrate the GHG emissions associated with the purchase of recycled or virgin paper products.

Overall, the choice between virgin and recycled paper does not make a significant difference to the amount of GHGs created. There are also other environmental impacts associated with paper production that should be given significant consideration. The numbers presented here should be used to give a good indication of the importance of paper products as a component of the overall carbon footprint of organisations, rather than to prefer virgin or recycled paper products.

THE EMISSION FACTORS

Impact category	Domestic		Imported	
	Virgin paper	Recycled paper	Virgin paper	Recycled paper
Total	1.3	1.52	1.08	1.28
Carbon dioxide (CO ₂)	1.22	1.45	0.991	1.19
Methane (CH ₄)	0.046	0.0416	0.060	0.056
Nitrous oxide (NO ₂)	0.028	0.0246	0.0299	0.022
Other	0.00308	0.00538	0.00321	0.00614

Summary of emission factors, kilogram CO₂-equivalent per kilogram of copy paper.

The table provides a summary of emissions, broken down by greenhouse gas. For this report, the unit used is the production of one kilogram of copy paper at

* This replaces publication 1374, released May 2011, to correct methane values in emission factors table.

market in Australia. We have assumed an average A4 ream of paper is 2.5 kilograms of copy paper.

We have attempted to take into consideration all relevant impacts when developing these factors, from extracting raw materials (principally wood fibre), pulping, paper production and delivery to the marketplace.

WHAT ISSUES INFLUENCE PAPER EMISSIONS FACTORS?

Two factors have the most significant influence the amount of GHG produced in manufacturing and transporting paper products. These are:

- the **energy mix of the grid electricity** used at the plant.
- the **energy source for the heat required for the pulping process**. In virgin paper production excess tree material is used as an energy source, whereas gas, oil and coal are used in the recycled paper system.

INCLUSIONS AND KEY ASSUMPTIONS

Very little data is available from paper producers on the greenhouse gas impacts of their operations. This study relies extensively on Australian Plantation Products and Paper Industry Council (APPPIC) data from 2006. Assumptions obtained from this source include the following:

- 40 per cent of paper is imported into Australia.
- 20 per cent of pulp is imported into Australia.
- Half of the energy input to the paper industry is from fossil fuels.

Alternative impacts of paper disposal when not recycled, such as landfill impacts, are also not included.

Domestic virgin paper

Virgin paper can be produced either at an integrated paper mill (where the pulping and paper production occur at the same facility) or a non-integrated paper mill. The integration of a paper mill reduces overall impacts, partly due to the availability of biomass energy (waste wood from trees used) and steam for use in different parts of the process.

Assumptions include the following:

- Based on the current Australian market it has been assumed that 75 per cent of domestic virgin paper is produced at an integrated mill and 25 per cent is produced at a non-integrated mill.
- Use of average Australian electricity factors.
- Transport from mill to market is assumed to be by articulated truck for 200 kilometres. This suits distribution in Victoria but may be an underestimate for other states.

The result is an average emissions factor for domestic virgin paper of 1.30 kilograms CO₂-equivalent, with a lower boundary of 0.7 and an upper boundary of 1.48 (using 95 per cent confidence limits).

Domestic recycled paper

The production process for recycled paper does not generate biomass energy (which is produced at integrated mills producing virgin paper).

Recycled paper production can take place with or without de-inking of the pulp. De-inking adds substantial impacts to the recycling process, but is required if post-consumer office paper is used to reproduce white recycled copy paper.

Assumptions include the following:

- 50 per cent of pulp is de-inked.
- Use of average Australian electricity factors.
- Transport from mill to market is assumed to be by articulated truck for 200 kilometres.

The result is an average emissions factor for domestic recycled paper of 1.52 kilograms CO₂-equivalent, with a lower boundary of 1.35 and an upper boundary of 1.7 (using 95 per cent confidence limits).

Carbon emissions from land transformation, which could occur when demand for virgin fibre increases, were not included in the recycled paper calculations.

Imported paper (virgin and recycled):

Emission factors for imported paper are calculated using the average emissions per kWh for grid electricity across Europe. This figure is significantly lower than emissions associated with Australian grid electricity (0.49kg CO₂-e per kWh compared to 1.29kg CO₂-e).

The imported virgin and recycled paper products used the same assumptions for the technology mix (75 per cent integrated mills for virgin production and 50 per cent de-inking for recycled paper production), but European electricity and material inputs are taken into consideration, as is additional transportation.

Shipping distance is assumed to be 15,000 km (an average of 10,000 from Asia and 20,000 from Europe) because:

- virgin paper is taken to be transported 20,000 kilometres from the Nordic region of Europe to Melbourne
- for recycled paper, a mix of Asian and European sources are assumed, as Asia is also a source
- international freight represents approximately 10 per cent of GHG emissions of imported paper products.

For all imported papers, 100 kilometres of road transport is assumed for cartage to and from the port.

The results are:

- an average emissions factor for imported recycled paper of 1.28 kilograms CO₂-equivalent, with a lower boundary of 1.17 and an upper boundary of 1.5 (using 95 per cent confidence limits)
- an average emissions factor for imported virgin paper of 1.08 kilograms CO₂-equivalent, with a lower boundary of 0.7 and an upper boundary of 1.48 (using 95 per cent confidence limits).

CHALLENGES

The lack of specific product data means that these emissions factors have high uncertainty, and emissions associated with individual paper products will vary greatly.

Imported virgin paper, if taken mostly from integrated mills in Europe, will have lower greenhouse gas impact than recycled paper, which includes substantial de-inking. Local recycled product had the highest greenhouse gas impact of all four options assessed.

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