Table 4: *Drying Methods and Environmental Sustainability*

Publication Details	**Principal Study Objective**	**Context**	**Hand Drying Device(s)**	**Study Design**	**Summary of Findings**
Berkowitz, 2015. US.	To examine the intensity (in dBA) of the noise produced by the air dryers in university campus restrooms.	Measurements were taken in eight restrooms and included three different manufacturers' products.	High airflow hand dryers.	Researchers measured the noise level in campus restrooms at a distance of 2.5 ft (approximately at an arm's length as one would use the dryer), 5 ft, and 10 ft (space permitting). Measurements were taken with a digital sound level meter. This sound level meter is accurate to +2 dBA. The researchers measured each hand dryer three times at each distance, taking the average reading for one drying cycle in each trial.	The small sample of electric hand dryers tested were mostly found to be producing higher levels of noise than that claimed by the manufacturer. None of the electric hand dryers were found to be safe for an 8 hour workday exposure.

Budisulistiorini, 2007. Australia.	Life Cycle Assessment (LCA) study to compare the environmental performance of two methods of hand drying. .	The study is located in the University of Melbourne, Parkville campus.	Paper towels and warm air dryer.	Production process of both methods are assumed and simulated in SimaPro software, to a generated database for impact assessment. The assessment method used in this study is Eco-Indicator 99.	From the LCA study, the warm air dryer performed better in most of indicators. Electric hand dryer by means of hand drying method, surpasses paper towel toward environment sustainability performances.
Gregory, Montalbo & Kirchain, 2013. US. ~~Montalbo, Gregory & Kirchain, 2011. US.~~	Evaluate environmental impact (with a focus on global warming potential) of five hand-drying systems. To incorporate uncertainty into this comparative LCA as a means of understanding the statistical robustness of the difference between the environmental impacts of the hand drying systems.	The scope of the study includes five hand drying systems. In addition to the dryers and towels, packaging is considered in all cases, as well as dispensers in the case of the towel systems and a waste bin and bin liners for the paper towel system.	Hands under dryers, high speed hands under dryers, high speed hands in dryers, cotton roll towels and paper towels.	LCA in accordance with the ISO 14040/14044 standards using data primarily from publicly available reports. As part of the study, a parameter uncertainty analysis was performed for multiple scenarios to evaluate the impact of uncertainty in input data on the relative performance of products. In addition, a probabilistic scenario analysis of key drying system parameters was conducted in order to	High speed dryers have a lower environmental impact and global warming potential than paper towels and cotton roll towels.

				understand the implications of changing assumptions on the outcomes of the analyses.	
Joseph etal, 2015. Canada.	Comparative LCA, under a cradle to gate scope, was carried out between two hand drying methods.	LCA study to assess and compare the life cycle environmental impact of using either paper towels or a warm air hand dryer which are two available hand drying methods at the University of Guelph (UoG) campus located in Ontario, Canada. The scope of this LCA is a cradle to gate system boundary and is applied to the different life cycle stages of the two product systems, right from material and manufacturing, transport of finished products and finally its use on campus at UoG. The end of life disposal and	Warm air dryer and dispenser issued roll paper towel.	A hands-under type warm air hand dryer, rated at 1800 watts, is compared to a controlled roll paper towel dispensing unit that issues paper towels made from 100% recycled paper. The case study is based on a United States manufacturing scenario for the hand dryer unit, the paper towel dispensing unit, the paper towel rolls as well as for all associated packaging for both the product systems. The electricity grid source mix powering the hand dryer unit during its use phase is	The use of a conventional hand dryer (rated at 1800 W and under a 30 second use intensity) has a lesser environmental impact than with using two paper towels (100% recycled content, unbleached and weighing 4 g) issued from a roll dispenser.

		recycling scenarios are excluded under the scope of this study.		based on the 2012 grid scenario in Ontario.	
Redway & Fawdar, 2008. UK.	Measure the drying efficiency of paper towel, warm air dryer and jet air dryer. Assess any potential contamination of users and the washroom environment caused by the use of paper towel, warm air dryer and jet air dryer.	The experimental protocol used in this study attempted to reproduce the public's usual hand washing and drying practices as closely as possible.	Paper towel, warm air dryer and jet air dryer.	Sets of 5 paper towels were placed in sterile plastic bags and weighed prior to use. Two volunteers were asked to dip their hands up to the wrists in warm water for 10 seconds, shake them thrice, and then dry them for 10 seconds using one of the 7 hand drying methods. All the water remaining on the surface of the hands was then carefully removed by the investigator with one of the sets of 5 pre-weighed paper towels using a standardised protocol for 40 seconds. The damp towels were returned to their plastic bag, re-weighed and	Paper towels are likely to cause considerably less contamination of other users and of the washroom environment than jet air dryers; which were found to disperse artificial hand contamination to a distance of at least 2 metres. Paper towels and warm air dryers produced more positive results than jet air dryers regarding contamination of the washroom environment. Paper towels created less contamination at 0 metres (directly below the device) than warm air dryers, although there was no significant difference at greater distances. In environments with jet air dryers such as public washrooms, noise levels could constitute a potential risk to those people exposed to it for long periods of time.

				the amount of water removed from the hands calculated. The operation was repeated using increasing drying times at 10-second intervals: 20, 30, 40, 50 and 60 seconds. The order of drying times and the drying methods were randomised to minimise any possible effect of external factors such as variations in room temperature, relative humidity or human behaviour.	