NCEA
NATIONAL CENTRE FOR ENGINEERING IN AGRICULTURE

30 November 2009

Helen Dugdale
Program Manager R&D Implementation
Cotton Research and Development Corporation
2 Lloyd Street / PO Box 282
Narrabri NSW 2390

Dear Helen,

RE: NEC15 Cotton Ginning Energy Study

Please find attached the final reporting requirement for project NEC 15. The final report for this project is in effect a dissertation (MEng) titled "ASSESSMENT OF ENERGY USAGE FOR COTTON GINS IN AUSTRALIA" by Ms Siti Amni Ismail. In addition to the analysis undertaken by Siti and presented in her dissertation I would also like to acknowledge the inputs of Dr Guangnan Chen and Mr Troy Symes who provided direction and assistance with data collection and instrumentation through out the process. I would also like to make a special mention of industry support via participating cotton gins as part of this study, in particular Queensland Cotton and Auscott.

At this stage Siti's dissertation has been submitted for assessment which will require independent examination before officially completing. I would suggest that in the current form the dissertation meets the final reporting requirements for this project however I would also like to request that publication is limited until the assessment process is completed.

To assess energy use within the cotton ginning sector, direct energy inputs which included electricity and gas (drying) were collated across the industry. Two levels of investigation were conducted i) basic level of assessment (whole of enterprise) and ii) detailed level of assessment (monitoring of individual motors) that was developed as a result of this study. The detailed monitoring process involved the measurement of power and energy for individual motors. For this purpose, the information of plant layout and motor rating was first analysed. To reduce the number of motors to be monitored, only the motors that operated under one line of the ginning process and motors greater than a specfic size was selected to further rationalise monitoring.

The basic level assessment involved the participation of 6 cotton gins while the detailed assessment involved monitoring at 2 of these sites. The analysis also included the conversion of all energy sources into a total green house gas emission (GHG) expressed in kilograms of CO_2 equivalents.

The average total energy use was 0.288 GJ / bale which equated to a GHG emission of 60.38 kg of $CO_{2\,(eq)}$ / bale. The average total energy cost was $10.70 / bale. Electricity and gas comprised of 61 % and 39 % respectively (**Figure 1**) of energy inputs compared to 77 % (electricity) and 23 % (gas) of the total energy cost (**Figure 2**).

Figure 1 Average Energy Use Profile

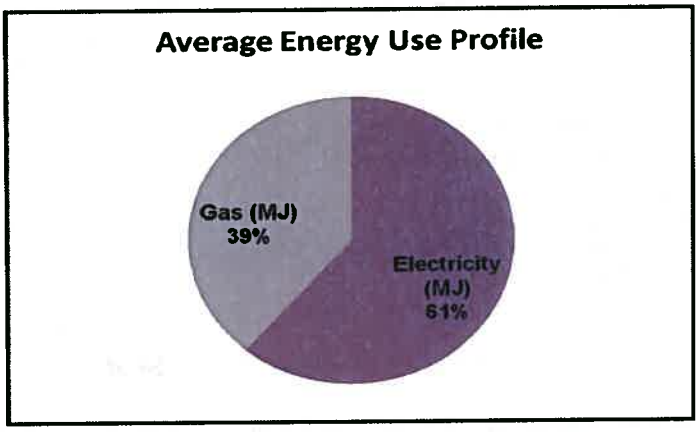
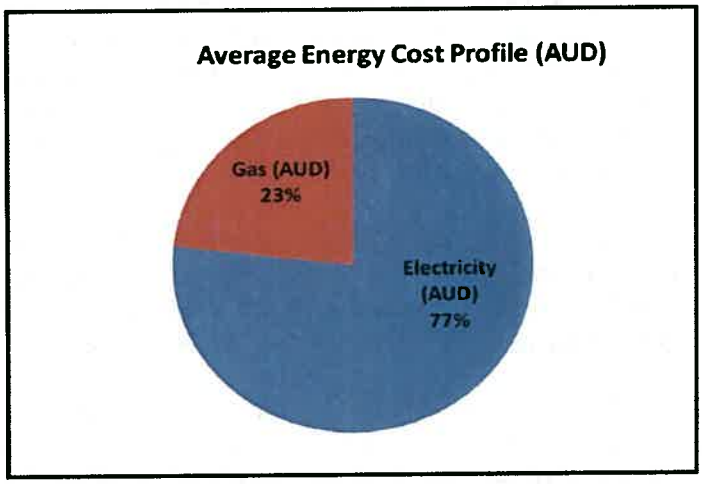


Figure 2 Average Energy Cost Profile



Electricity

Electricity usage (kWh) ranged from 46-58 kWh per bale, while the electricity cost per bale was found to range from $5.12-$11.94 /bale (Table 1). Cleaning and handling processes were found to have a higher electricity use than other processes and used 70 percent of the total electricity required (Table 2). Detailed monitoring and analysis found that cotton variety had a significant influence on total energy use (maximum energy use doubled).

Table 1 Electricity Use and Costs

Gin	Capacity (bales/hour)	Electricity (kWh/bale)	Energy Use (GJ/bale)	Electricity ($/bale)
Gin A	40	48.80	0.176	5.22
Gin B	54	47.80	0.172	4.60
Gin C	60	52.28	0.183	11.94
Gin D	30	58.00	0.209	6.96
Gin E	24	46.50	0.167	5.12
Gin F	40	58.55	0.211	7.47

Table 2 Percentage of Maximum Energy Demand

Gin	Cleaning	Ginning	Packaging	Handling
Gin A	34%	14%	12%	39%
Gin B	38%	15%	10%	37%
Gin C	32%	13%	13%	41%
Gin D	41%	15%	9%	35%
Gin E	32%	13%	15%	40%
Gin F	35%	14%	22%	28%

Gas

Gas is consumed for the drying of cotton within in the gin. Higher air temperature is used to reduce the incoming moisture content of a module. For normal harvest seasons, the drying process uses about 0.74-3.90 m^3/bale of natural gas and 2.27-5.61 litres/bale of LP gas (Table 3). On average, drying uses about 0.1 GJ/bale of energy which is less than half recorded overseas (Anthony and Eckley, 1994). The cost of gas in producing one bale ranged between $0.98-$3.39/bale. Generally the lowest cost occurred where Natural Gas was used.

Table 3 Gas Use and Cost

	Capacity (bales/hour)	Natural Gas (m3/bale)	LPG (litres/bale)	Energy Use (GJ/bale)	Gas cost ($/bale)
Gin A	40		5.61	0.148	3.39
Gin B	54		4.31	0.114	2.65
Gin C	60	0.74		0.029	0.98
Gin D	30		3.85	0.102	2.33
Gin E	24	3.9		0.154	1.14
Gin F	40		2.27	0.06	1.3

It can be seen that Gin C and Gin F were among the lowest gas users where they recorded 0.029 and 0.061 GJ/bale respectively. This was attributed to the practice of using the dryer when incoming cotton contained more than 8% moisture and represented a saving of up to $2 / bale in energy costs. Other factors such as trash content and lint quality on total energy use were less apparent. These factors may in fact have indirect influences on total energy ie where the dryer is started earlier to improve the cleaning process at high trash content. Similarly these and other factors may influence energy use if production rate is significantly reduced.

Yours sincerely

Craig Baillie
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