Energy analysis of a case-study textile mill by using real-time energy data

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ECEEE summer study June 02-05, 2014 Arnhem, Netherlands

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Overview

- Energy compliance and competitive business market
- Textile is a fragmented and heterogeneous SME
- Energy consumption in the industry is very site specific
- In the UK textile is responsible for 0.4% of the nation's total energy use

Rationale

- More tailored programmes are needed to address an SME's individual technology-specific energy management needs.

- Little attention has been paid to the development of energy use and energy efficiency in the available literature on the textile industry.

- To control the energy consumption and cost in a system or process it is imperative to measure its energy use first.

key objectives are:

- To develop understanding about baseline energy use and energy trends and patterns
- To identify season related variation in energy intensity and disaggregate energy use
- To pinpoint efficiency opportunities and estimate the savings

Research approach

High resolution empirical energy data has been used for energy analyses in several studies. Average daily energy profiles are calculated against shift patterns to,

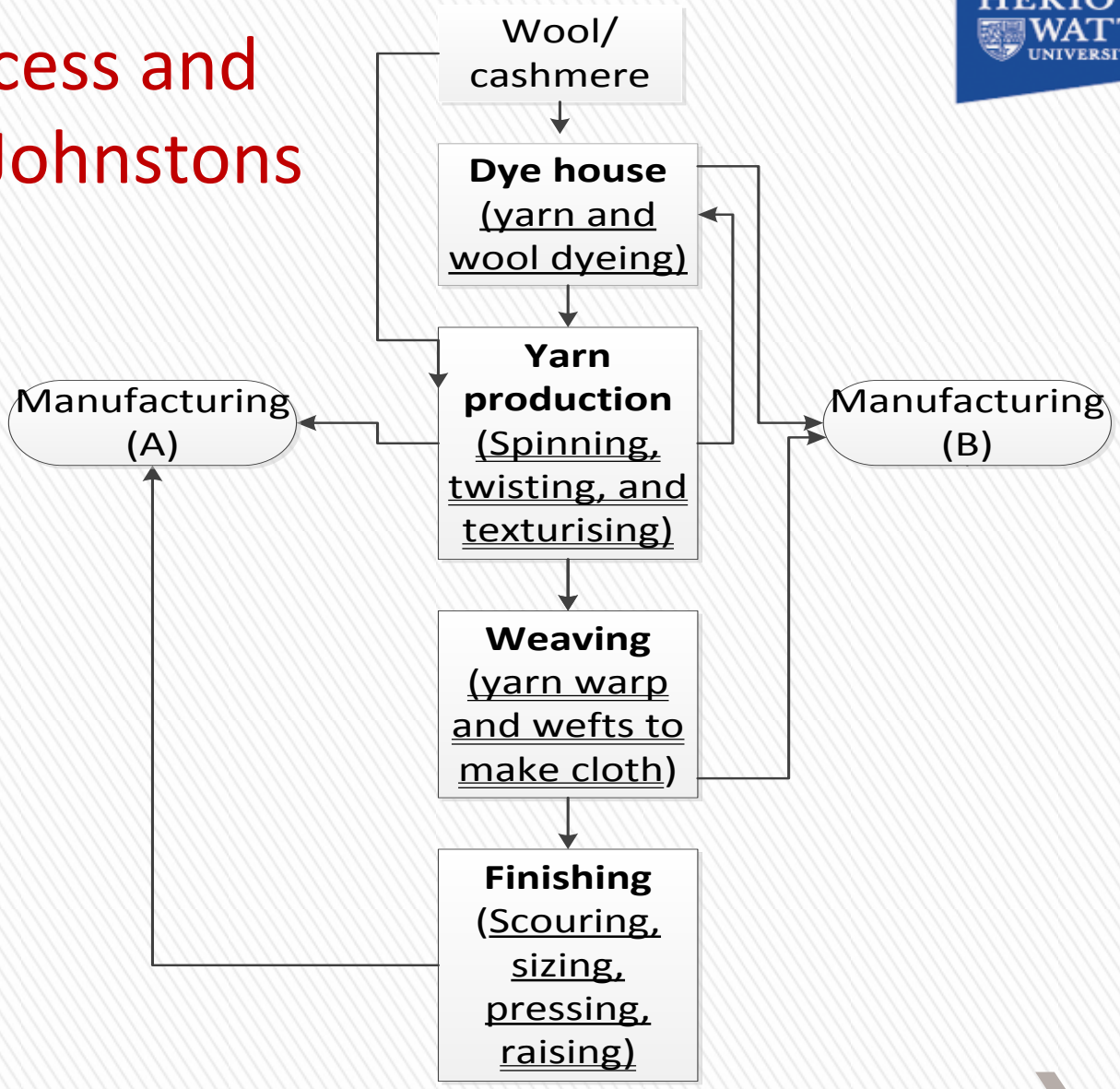
- visualise and understand energy use at short intervals
- pinpoint abnormal use, faults and failures
- Identify saving opportunities

A different approach has been used to disaggregate departmental load and gas use.

Case study site and energy analysis

- Johnstons of Elgin is a 200 years old vertically integrated woollen mill
- 22, 800m^2 treated area, consisting of both production and administration buildings
- Sales driven therefore varying rates of production and shift patterns
- Only two gas user technologies- boilers and a fabric dryer called “stenter”
- On-production (Mar-Sep) off-production (Oct-Feb)

Production process and energy flow at Johnstons



In brackets, single underlined text is predominantly gas based thermal energy and double underlined text is electric

2005 total energy consumption

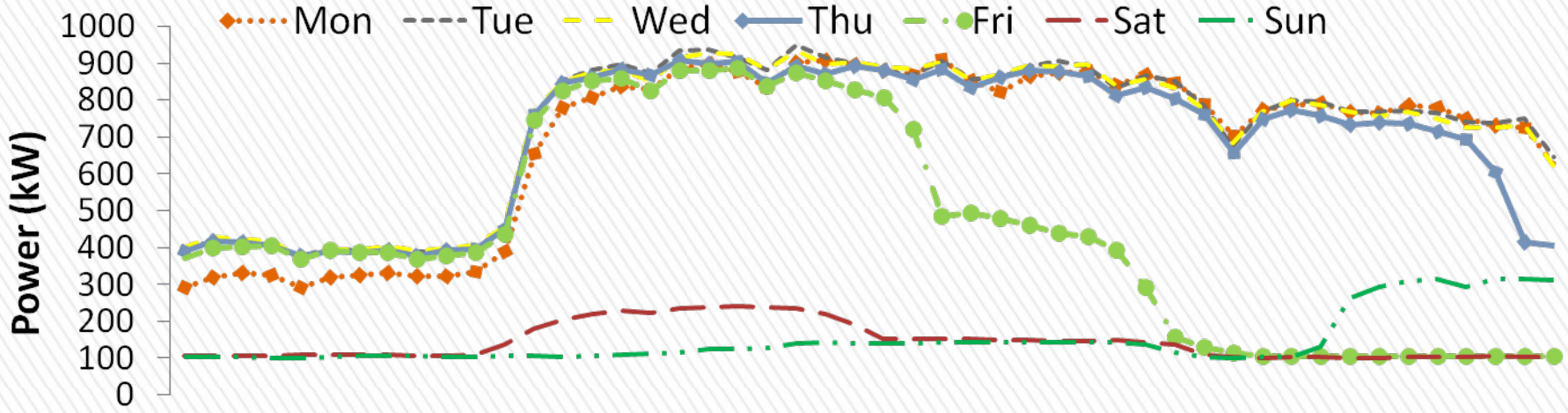
2005 Prices Utility	Energy Consumption		Cost		Specific Energy Consumption kW·h /unit	Specific Energy Consumption kW·h /meter
	MWh/year	%	€/year	%		
Electric	4,342.86	20	284,020	47.9	1.74	N/A
Gas	16,994.51*	79.6	309,116	52.1	6.8	N/A
Total Energy	21,337.37		593,136		8.54	

source: Carbon Trust's 2006 survey report

2011 total energy consumption

2011 Prices Utility	Energy Consumption		Cost		Specific Energy Consumption kW·h /unit invoiced	Specific Energy Consumption kW·h /meter
	MWh/year	%	€/year	%		
Electric	4,147.61	19.33	469,168	48.65	1.81	3.67
Gas	17,313.05*	80.67	495,107	51.35	7.54	15.34
Total Energy	21,461.66		964,274		9.35	19.01

*based on supplier's estimate invoices



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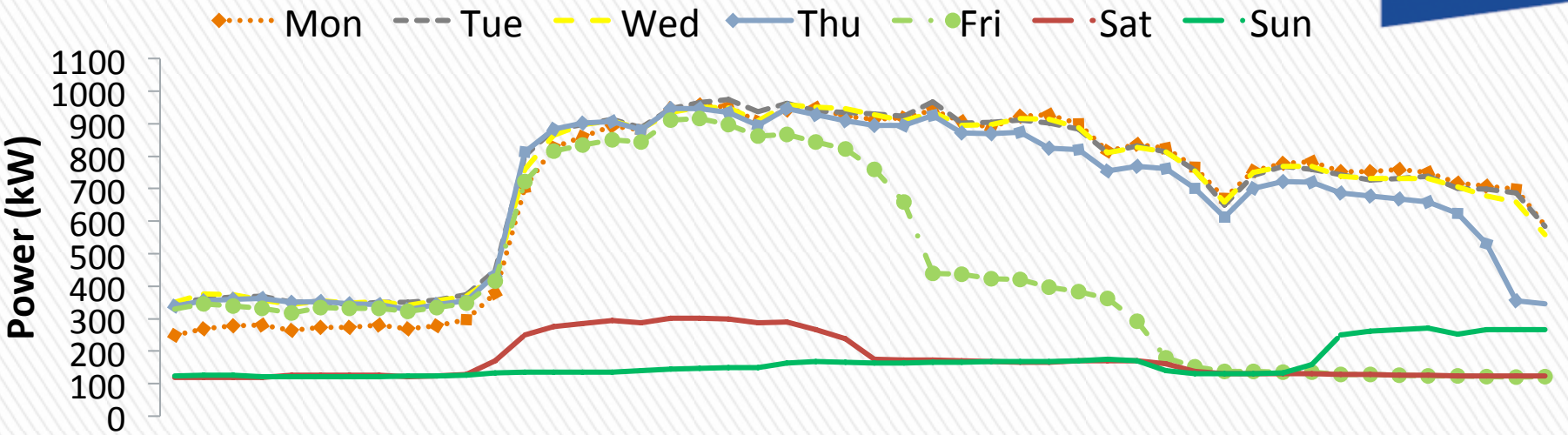
i)Mfg. (A)						↓																		↑
i)Mfg. (B)	→																							→
ii)Operations						↓(1	↓(2	↓(4	↓(2)			↑(2)			↑(1	↑(1	↑(4	↑(1)						
ii)Mfg. (A)						↓						↑												
ii)Mfg. (B)												↑(DH)				↑(W)								
iii)Retail (R)+OT						↓(OT)		↓(R.)			↑(OT)							↑(R.)						
iv)Retail											↓							↑	↓(	W+DH)				→

2011 average on-season electric power demand

Legend

→	↓	↑	i	ii	iii	iv
Continued	Starting	Finishing	Mon-Thursday	Friday	Saturday	Sunday



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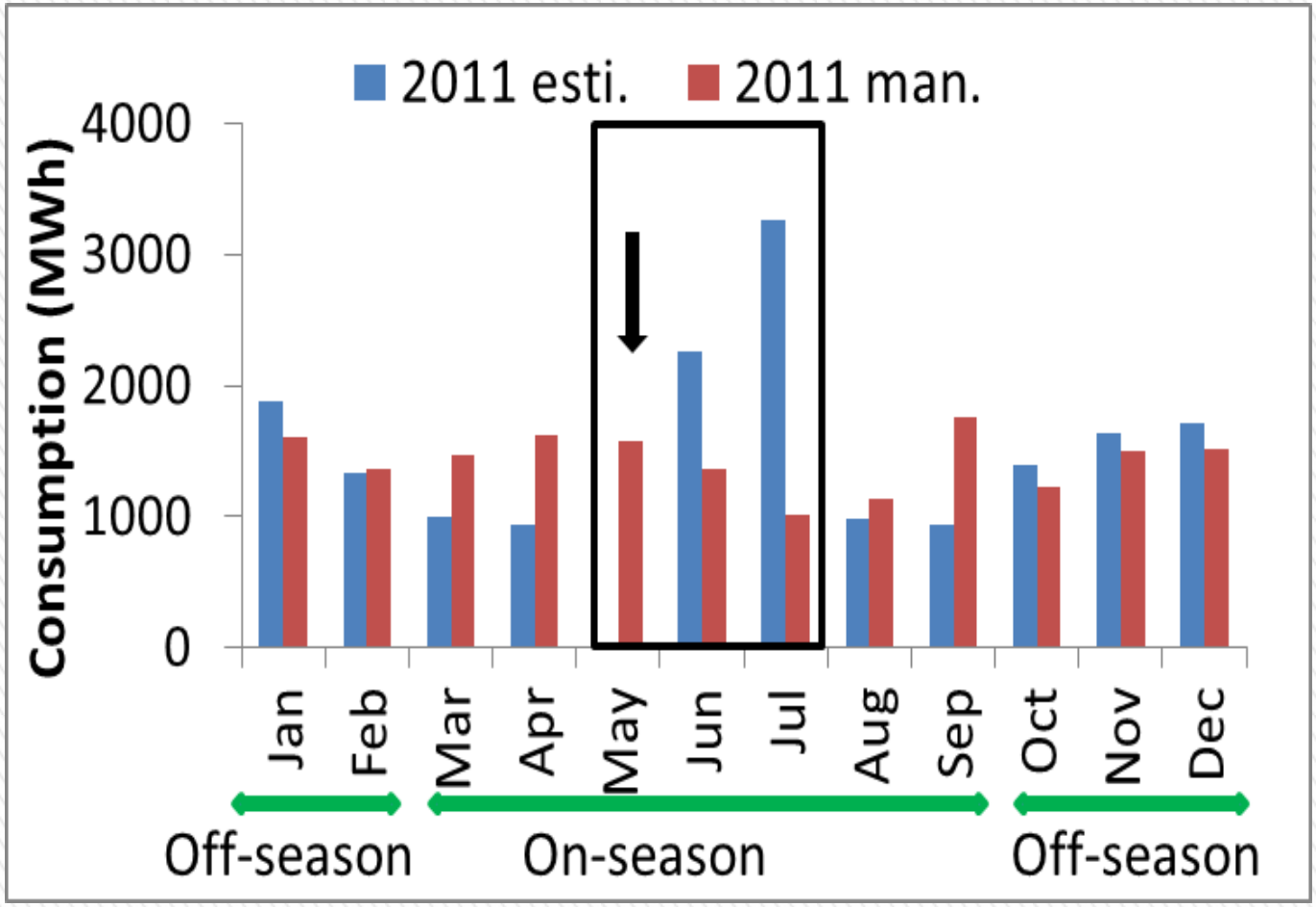
ii)Mfg. (A)						↓						↑												
ii)Mfg. (B)												↑(DH)				↑(W)								
iii)Retail (R)+OT					↓(OT)			↓(R.)			↑(OT)						↑(R.)							
iv)Retail											↓							↑	↓(W+DH)					→

2011 average off-season electric power demand

Legend

→	↓	↑	i	ii	iii	iv
Continued	Starting	Finishing	Mon-Thursday	Friday	Saturday	Sunday

2011 Monthly gas consumption



Gas consumption

Average daily gas demand for,			
Boilers	Stenter	Other heating and cooking	Total
3663 (m^3)	918 (m^3)	140 (m^3)	4725 (m^3)
40700 (kWh)	10200 (kWh)	1555 (kWh)	52500 (kWh)

2013 gas consumption figures

Building heating demand= 213,698 m^3 or 2,374MWh

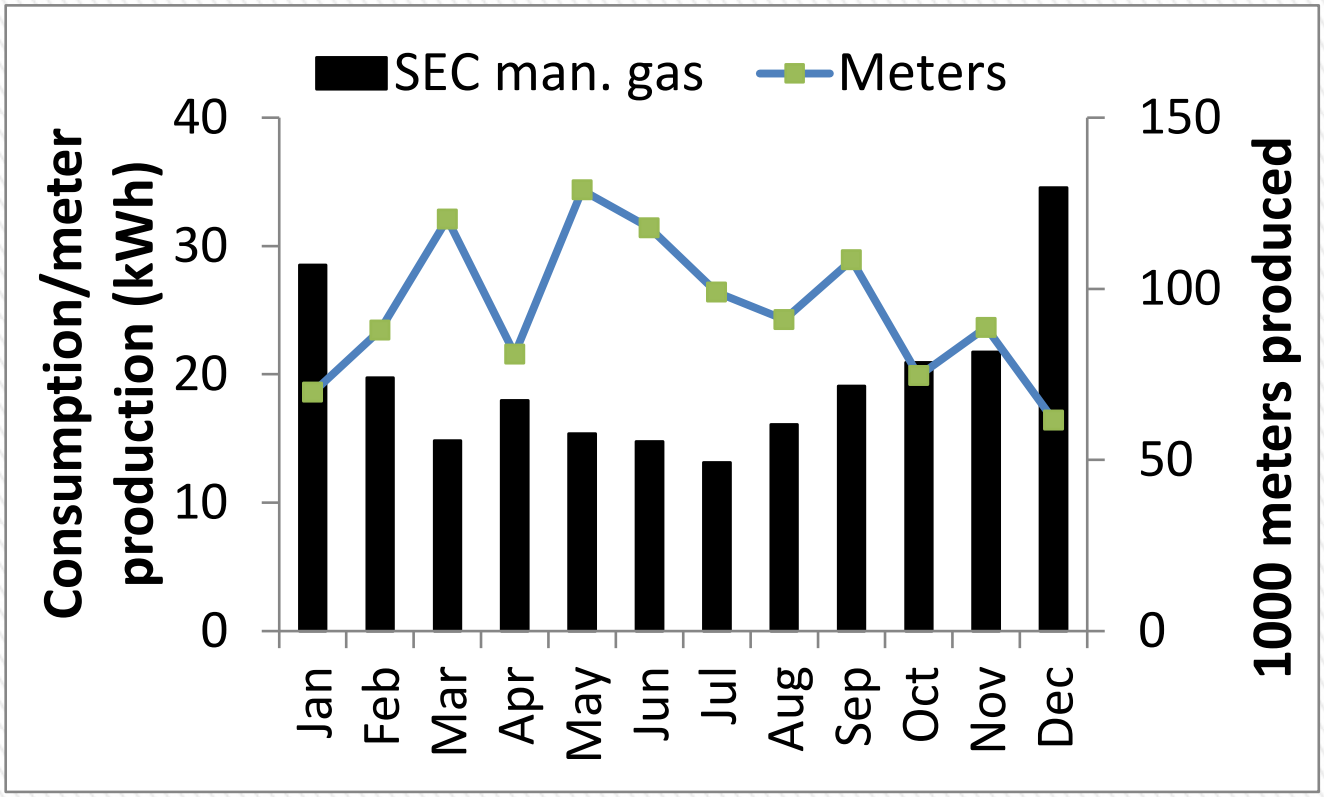
Production demand= 1,312,332 m^3 or 14,581MWh

Electricity demand (kW)

Base load	Production and operation	Production only	Operation only	Dye house + Weaving+ Yarn store	Finishing and Yarn production
118	919	711	208	362	349

Average departmental disaggregated load (kW)

Specific energy consumption per metre production



2011 specific energy consumption per meter of production

Some identified saving opportunities

HVAC systems

- Temperature, schedule, and behaviour

Motors

- Resizing, efficient motors, and VSDs

Industry specific tech

- Stenter (Behaviour and component).
- Reduction in water use

Cross-cutting technology

- Weekend boiler management
- Improved compressed air units

Lighting

- LED lighting
- 8ft T12 fluorescent lighting

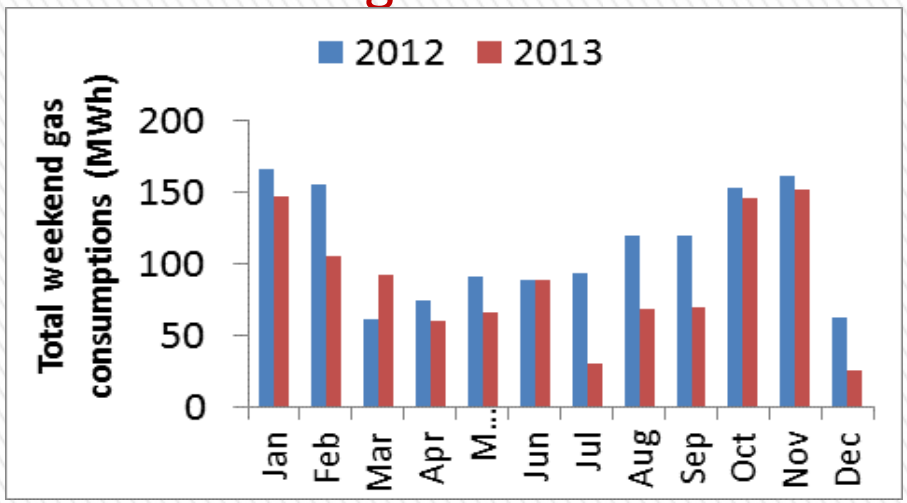
Energy recovery

- Heat recovery in the dyehouse
- Heat recovery from the stenter

As a result of energy conservation work started in February 2013, following initiatives were taken;

- "Sustainable Together" awareness raising campaign
- Weekend boiler management
- Improved boiler and steam system
- Prompt steam/boiler shutdowns
- Installation of AMR on gas meter

- Gas savings



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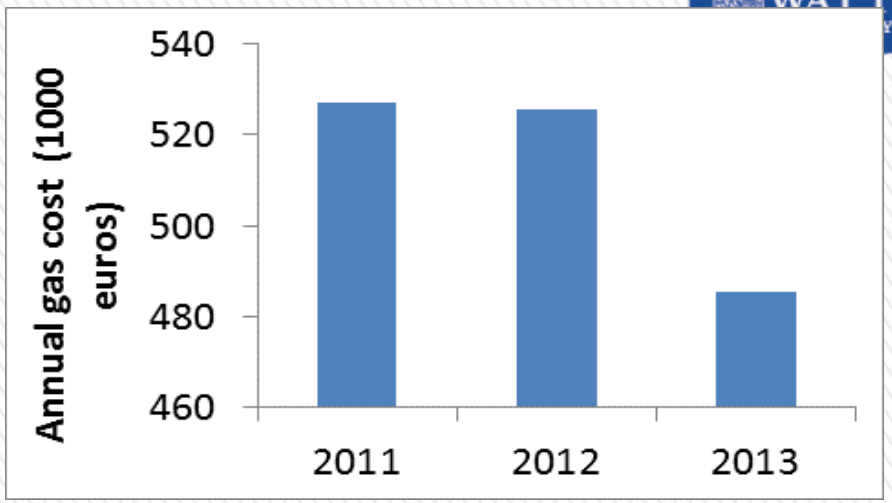

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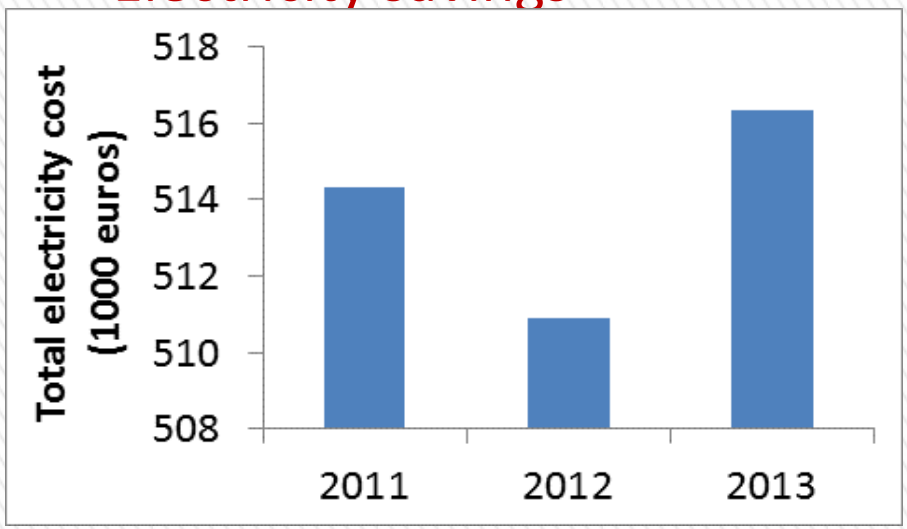
- Electricity savings



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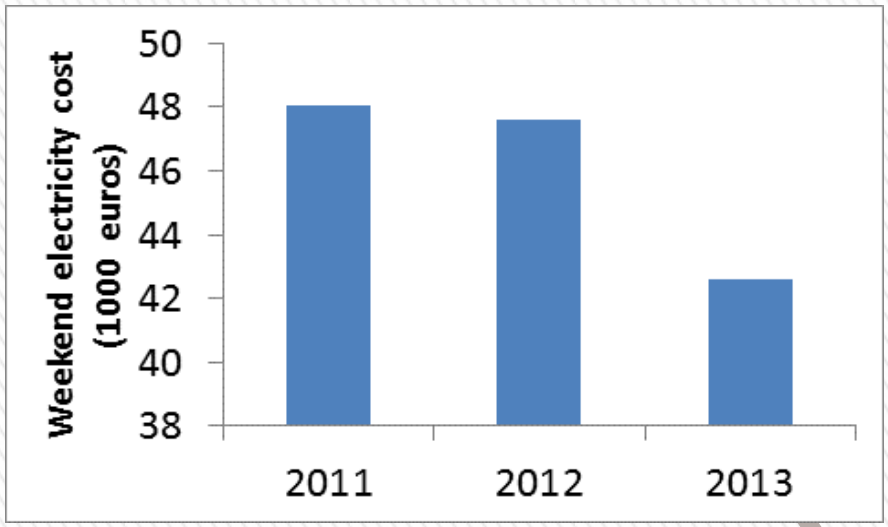

D

Calculations based on cost (€) per unit (kWh)

Gas=	0.04
Electricity=	0.13

Conclusion

- Energy use in the textile is industry specific
- 60% rise in energy cost within the last six years
- Variation in energy trends and patterns is weather and rate of production influenced
- Estimate and missing gas bills can misguide energy analysis and production costing
- Energy saving actions has yielded encouraging results

Conclusion cont.

- **Continuous energy management is required**

Energy efficiency investigations for other technologies are ongoing. Studies for embedded energy for a certain product line is intended to be carried out in the near future.

Acknowledgements
This study is part of a PhD project funded by the textile company Johnstons of Elgin, in collaboration with Heriot-Watt University

Thank you!

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Questions/suggestions?