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Reducing Energy and Water in Breweries

Gary Freeman and Anastassia Johnson

Purpose

- Overview of brewing industry performance
- Performance over product lifecycles
  - The benefits of lifecycle analysis
- Efficient use of fuel
- Detail of energy usage in the plant
- Water security
- Dissemination of advice and experience

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Specific Energy Consumption (SEC) Benchmark Results

Year	Number of breweries	Specific Energy Consumption (SEC)			
		Average	Standard deviation	Median	Decile
		[MJ/hl]	[MJ/hl]	[MJ/hl]	[MJ/hl]
1999	86	271	64	261	193
2003	158	239	60	233	176
2007	143	229	71	220	156

- 11% reduction in world-top energy usage 2003-2007 (top 10% performance)

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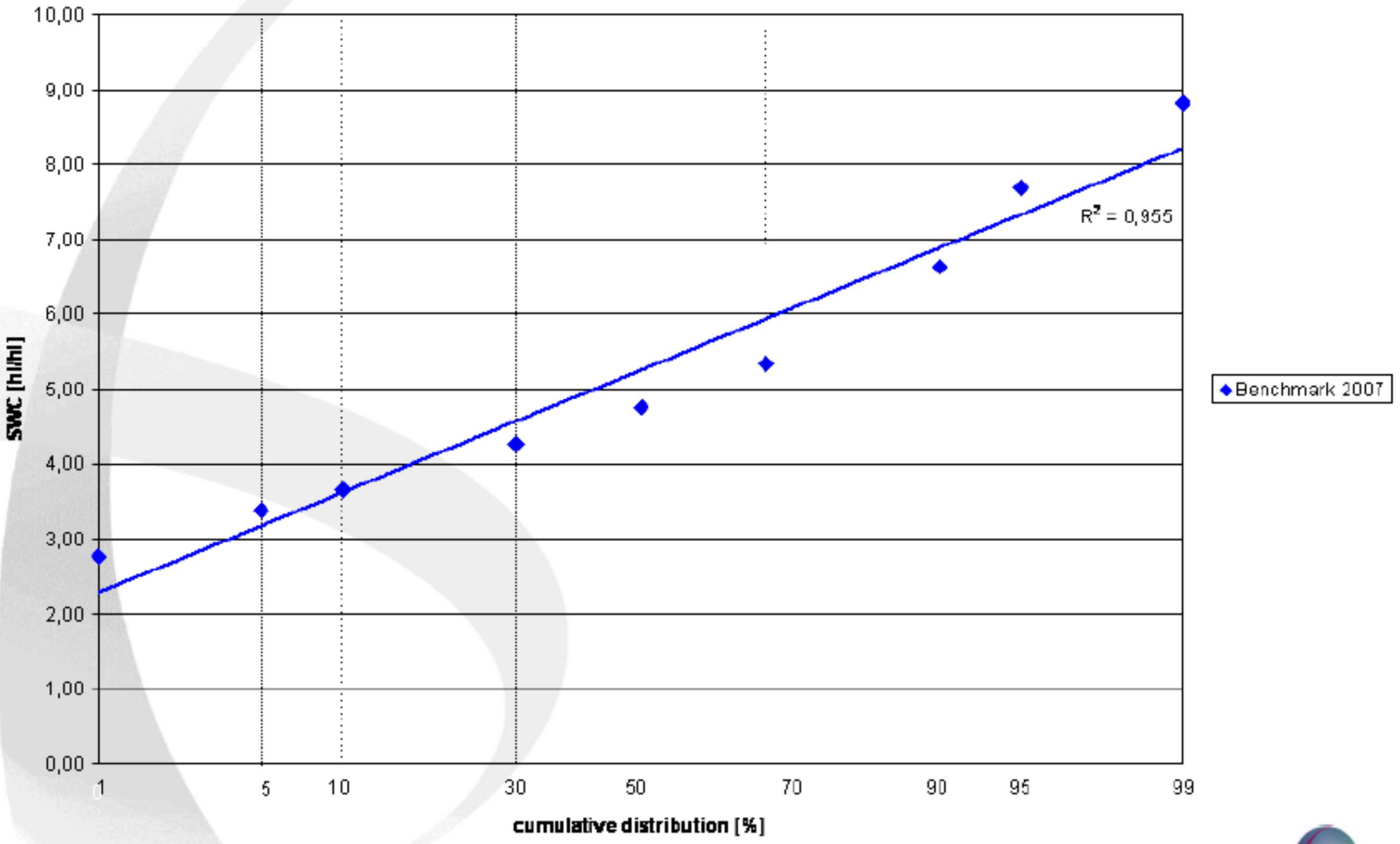
Specific Water Consumption



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Performance of Major Brewers

- SAB Miller
  - To 31st March 2012
  - Water consumption for lager at 4.0hl/hl
  - 13% improvement on 2008
  - Energy use constant at 138MJ/hl 12 months to 31/3/12
  - But carbon footprint down 10% because of cleaner, more efficient fuel usage

Heineken

- To 31st December 2011
- ~90% beer, some cider, soft drinks, water
- Total energy consumption 113 MJ/hl from 122 MJ/hl in 2009
- Production site carbon emissions 8.6 $kgCO_{2e}$/hl in 2011, from 9.1 $kgCO_{2e}$/hl in 2009
- Water consumption 4.3 hl/hl in 2011 from 4.8 hl/hl in 2009

Diageo

- Beer is 22% of net sales (22Mhl in 2011)
- For all drinks:
  - Carbon emissions down 22% from 2007-2012
  - Water efficiency improved 19% from 2007 to 2012

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Carbon Footprinting

- 'The total set of greenhouse gases (expressed in CO_2 emitted) entering the atmosphere as the result of a given activity or product'
- We can carbon footprint a country, business, person or product
- Most useful is the carbon footprint of each of our products: PRODUCT CARBON FOOTPRINTING
  - a holistic view of your greenhouse gas footprint

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Why Product Carbon Footprinting?

- Reduction in carbon emissions through identification of potential cost savings and assisting decision making on suppliers, technologies, raw materials *etc.*
  - *Best opportunities with "worst" carbon footprint product*
  - *KPI for ongoing improvement*
  - *Cost savings*
- Improved relationships with certain consumers, legislators and regulators.
  - *Highlight lowest carbon footprint product?*
  - *Demonstrate corporate responsibility*
  - *Customer or retailer may demand the information*
  - *What is your objective for carbon footprinting?*

Methodology

- In the UK a second edition “standard” has just been published PAS2050
- Employ your own data or supplier data whenever possible

  (Consider employing data from literature or databases)

  But this will reduce certainty (tolerance) of result
- Carbon Footprint = Σ (activity data × emission factor)

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Packaging

- Glass packaging
  - Bottle is a major contributor to overall product energy input
    - Perhaps in excess of 20% of product carbon footprint
- Opportunities
  - Recycling. Recycled glass requires a lower furnace temperature.
    - 500 ml bottle: Recycled 571 gCO_{2e}, Virgin 738 gCO_{2e}
    - So 10% recyclate in bottle equivalent to 2-3% reduction in carbon emissions from bottle manufacture
  - Lightweighting
    - Direct proportional reduction in carbon emissions
    - Cost reductions to brewer
    - UK: Bottle suppliers utilised Government funding
    - Reduced on average 10% of bottle mass in UK industry
    - Conservatively 10% reduction in purchase cost to UK brewers (2008 prices)

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Combined Heat and Power (CHP, Cogeneration)

An energy economy measure

- Cogeneration of *heat* and *electricity* to maximise output from each unit of primary fuel
    - Catch the heat that normally is lost with flue gases
    - Conventional power generation 45% efficient but CHP typically 80% efficient
    - CHP typically 34% electricity, 46% heat, 20% losses based on available energy in fuel
- Ratio of electricity to heat typically but could be different depending on type of CHP plant
    - Most commonly for brewers gas turbines
- CO_2 emissions from site increase?!
- But legitimate to offset these emissions if putting electricity into grid
    - This could affect economic viability

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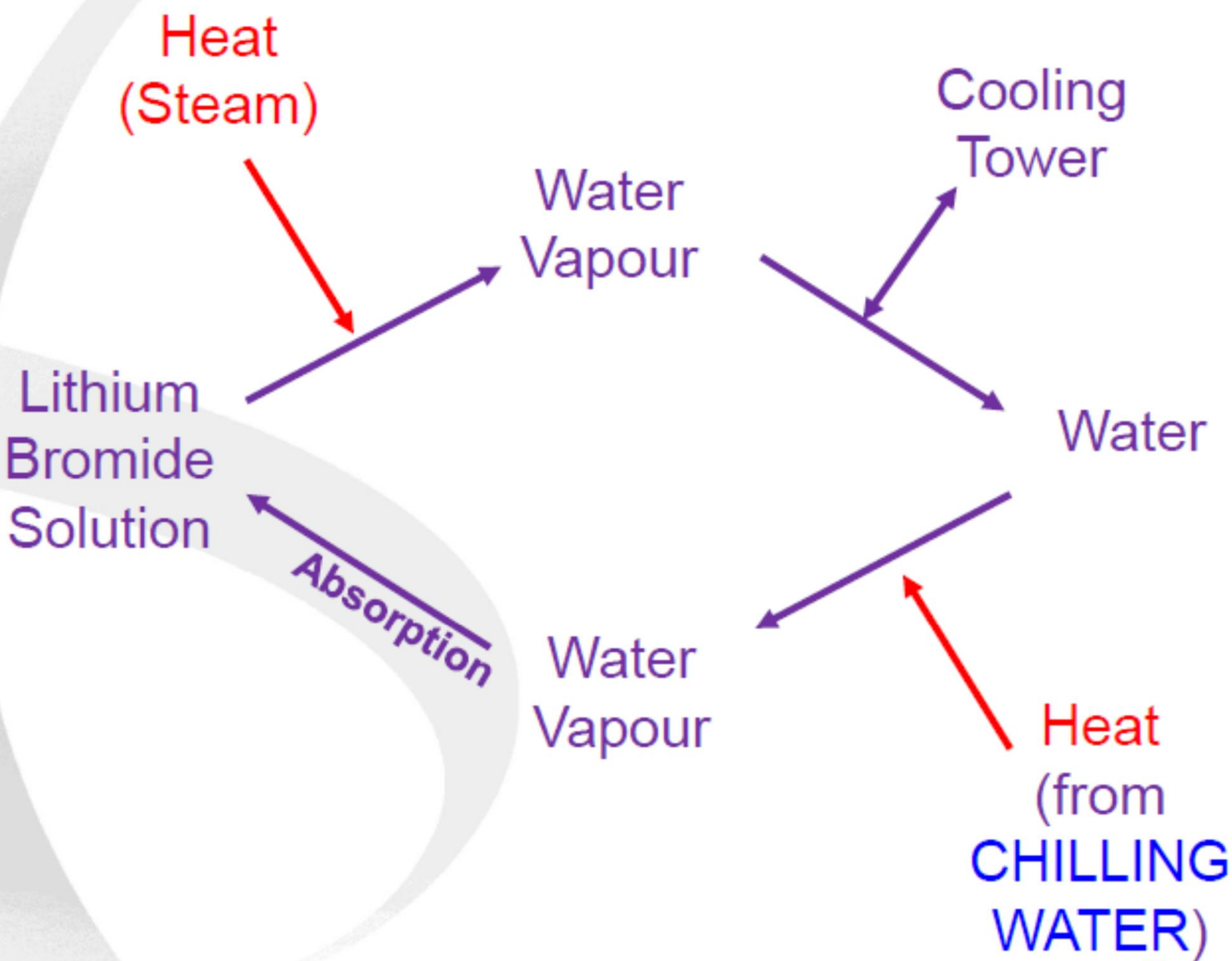
Making Cogeneration Feasible

- Economic benefits will depend on local/process circumstances
- Size the plant according to the need for heat
- District heating may increase viable heat load
  - employed in Central Europe
  - on site heating *e.g* offices?
  - similarly, Bowmore Distillery, heating of a swimming pool!
- How much will is capital expenditure?
  - Size on the need for heat
  - Hence estimate electrical power output
  - First estimate is $600 per kW electrical (depends on scale)
- Trigeneration (polygeneration)
  - Absorption chiller
  - Increases heat demand, larger more viable plant?

Absorption Cooling

(Refrigeration by Moving Water around a Vacuum System)



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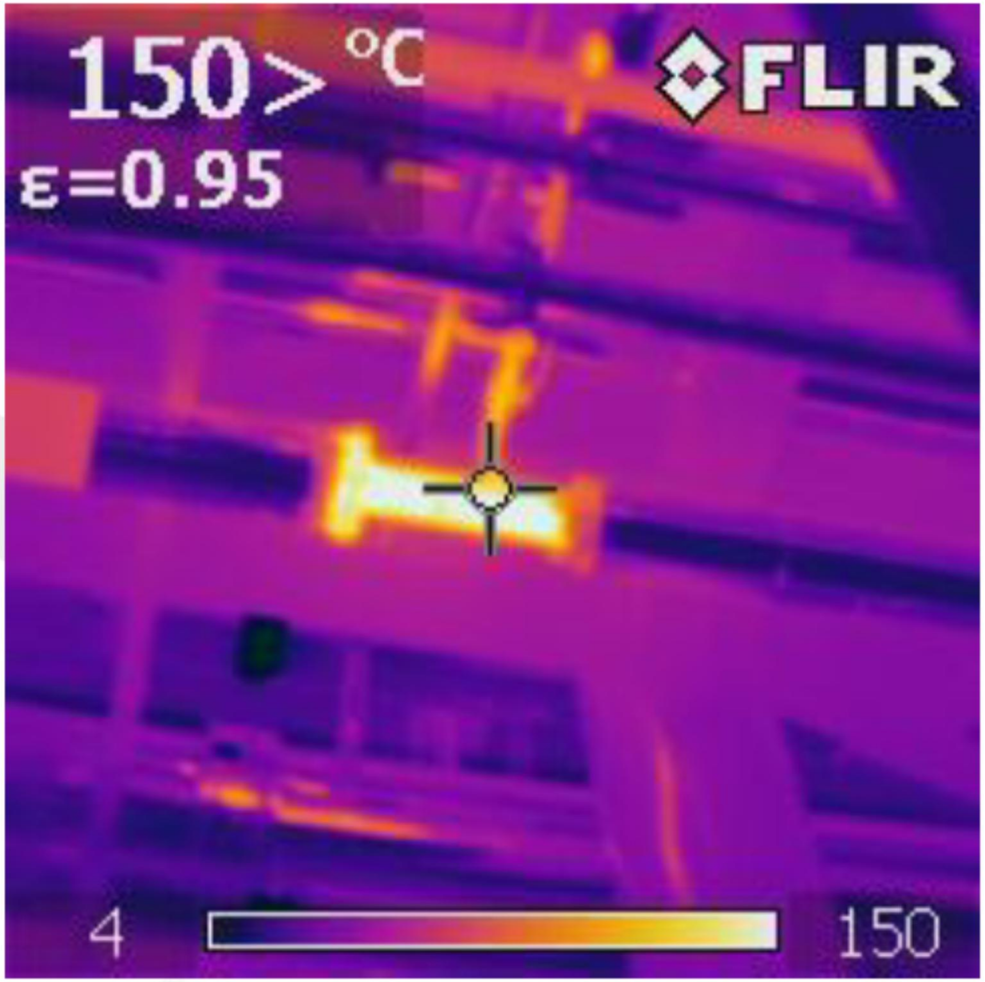
Thermal Imaging for Energy Conservation

Example: Steam Main in Packaging Hall



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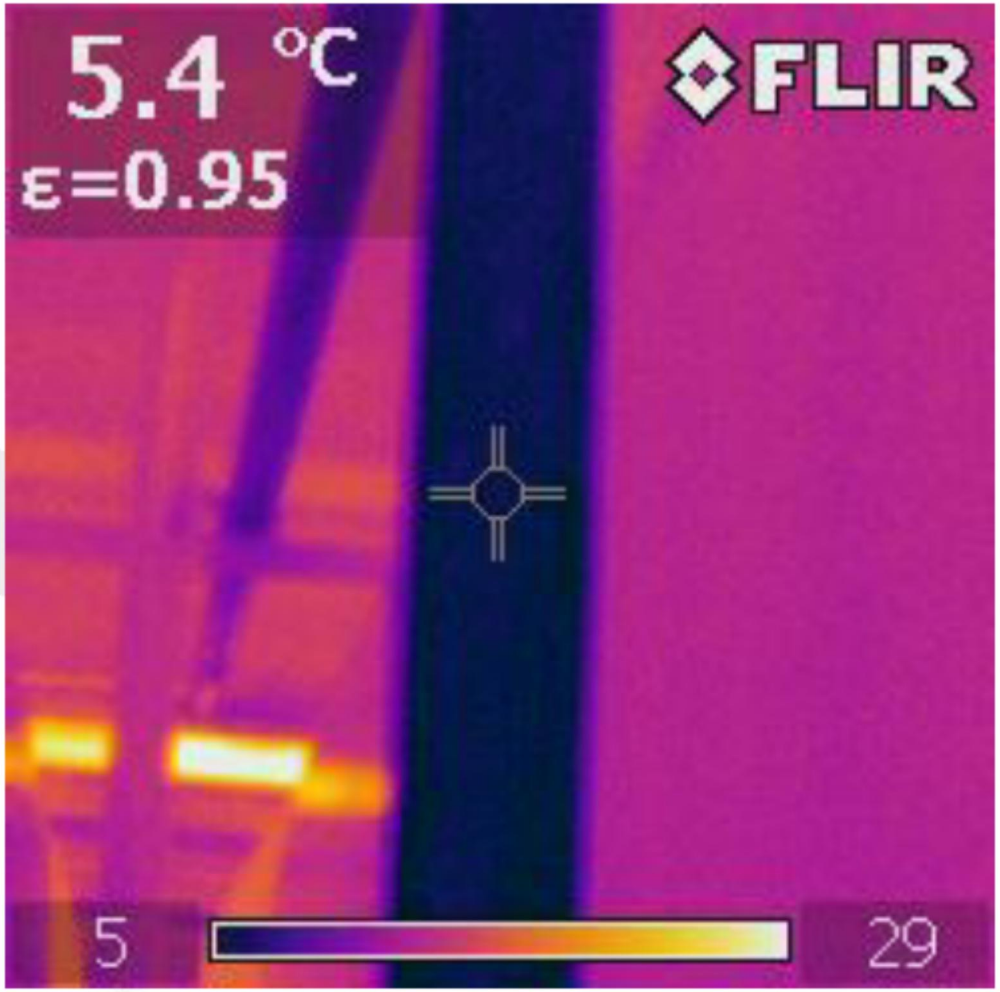
Thermal Imaging for Energy Conservation

Example: Transfer Main from Cold Storage



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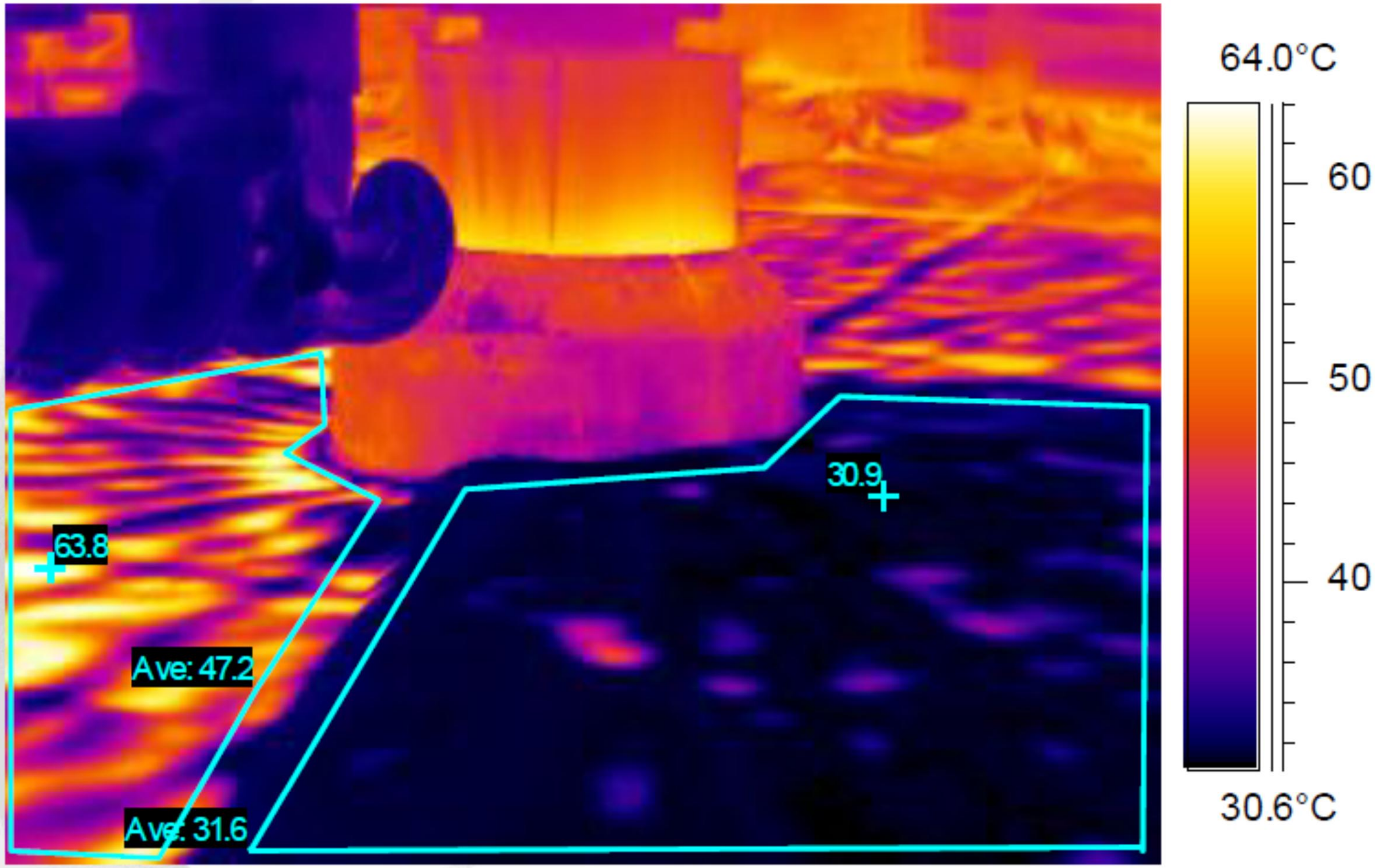
Thermal Imaging for Energy Conservation

Example: Malt Kilning



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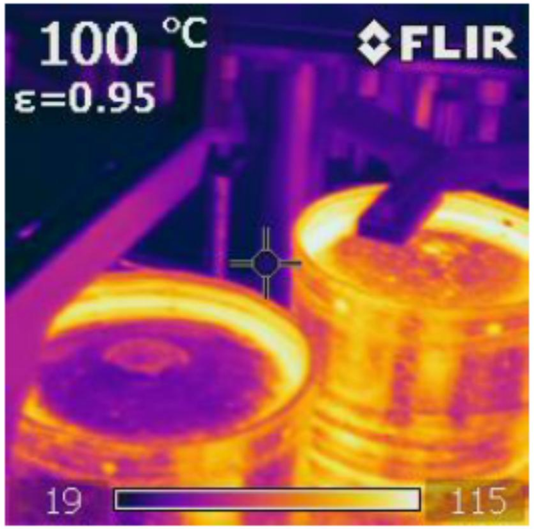
Thermal Imaging of Process

- Has been employed to look for unsound electrical connections
- Equally applicable to looking for energy inefficiencies
- Simple and obvious results
- Poor, damaged or absent lagging
    - Hot and cold process
- Product quality
    - Temperature maintenance in mashing processes
    - Maintaining low temperature in beer processing
    - Sterilisation processes in container racking



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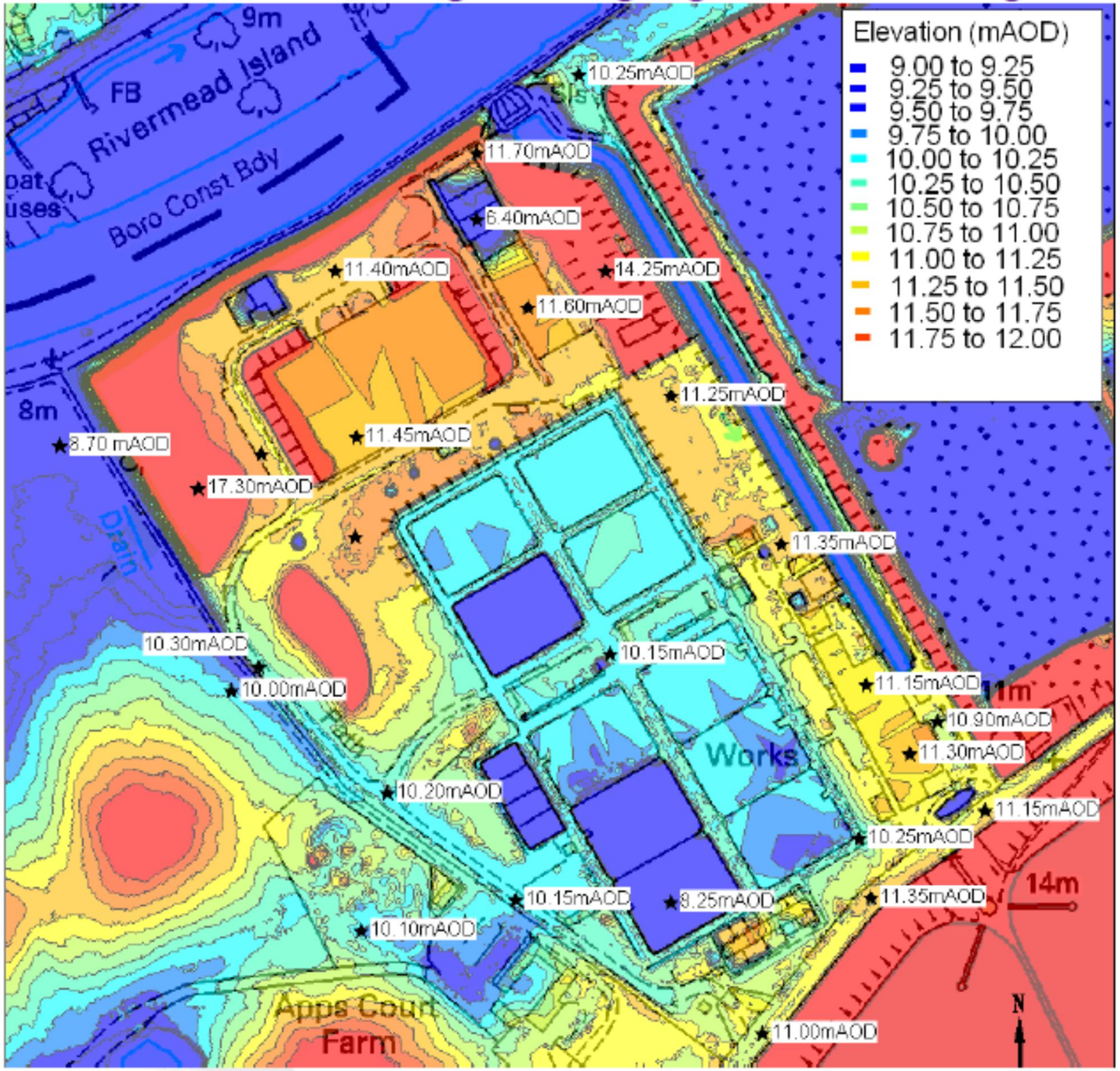
Safeguarding against Flooding



- Heights "Above Ordnance Datum" (AOD)
- Blue areas most vulnerable to flooding
- Identify most significant risks *e.g.* loss of expensive machinery
- Storm risks *e.g.* every ten years, fifty years, one hundred years…
- Forecasts on global warming effect

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Groundwater Contamination

- WHAT ARE THE THREATS TO YOUR BUSINESS?
- Source – Pathway – Receptor
- Receptor
  - Where you get your water from
    - In particular boreholes, wells, abstractions
- Source
  - What's in your area that could feasibly contaminate your groundwater?
  - *e.g.* users of chemicals, agrochemicals, petrol garages…
- Pathway
  - Is there a Pathway?
  - Source extremely close to Receptor?
  - Else how long does it take to get there?
    - More than 400 days may not be a problem
    - Less than 50 days are high priority considerations
- Risk Assessment
- Mitigations
  - Maintenance condition of the abstraction
  - Else potential for major problems

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Campden BRI – IBD Environmental Website

- **www.sustainablebrewing.com**
- First version 2006
- Ninety-two pages of information
- In 2011/2012 a further Grant enabled Case Studies to be added
- Website is free to use and open to all

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Campden BRI – IBD Environmental Website

Campden BRI Campden BRI Brewing Division Home

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Environmental Protocols
for the brewing and distilling industries

IBD Institute of Brewing & Distilling

Home
Brewing
Distilling
Open Index

Campden BRI Environment Protocols for Brewing and Distilling Industries

Welcome to the Campden BRI/Institute of Brewing and Distilling (IBD) website which provides Protocols for the Auditing of Water and Energy Usage and Waste Management in the Brewing and Distilling Industries. The protocols on this website are to act as a guide to help breweries and distilleries who wish to carry out internal audits in their brewery or distillery. The suggestions can save on costs through improving processes and reducing energy and water consumption. There are also instructions for waste and emissions reduction. The protocols are now supported by actual case studies which will help in the delivery of measures to reduce energy usage and discharges.

These protocols were prepared in 2006 by Campden BRI with the support of the Grants Committee of the Institute of Brewing and Distilling (IBD).The Case studies have been researched and added to this site through a further grant from the IBD in 2011/12.

The web site is split into Brewing and Distilling. Select you industry you are interested in, followed by the area you wish to focus on. You may then go through the suggestions for each process.

For more information regarding the Institute of Brewing and Distilling visit their web site http://www.ibd.org.uk.

Related Items

Brewing >
Distilling >

Campden BRI, Centenary Hall, Nutfield, Surrey, RH1 4HY, United Kingdom, Telephone: +44 (0) 1737 822272

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Case Studies

Case study: Solar heating at Hofmuehl Brewery

Show/Hide

Case study: Hofbrauhaus Wolters install new boilerhouse. Copper evaporation optimised for ideal energy recovery.

Show/Hide

The history of the brewing enterprise now known as Hofbrauhaus Wolters can be traced back to 1647, but in its present form it dates only from 2006, when it was refounded as an independent company following a management buyout from InBev Deutschland (which had acquired it in 2003). The recent refurbishment of its brewhouse is described. A GEA Brewery Systems "OTAS" process control system, covering all the brewhouse vessels and ancillary systems, has been installed. The wort copper has been retrofitted with a GEA "Jetstar" internal boiling heater, but also retains a heating jacket on its bottom, to enable it to boil smaller quantities of wort than the main heater can handle. This feature allows the brewery to produce speciality beers in styles for which demand is limited; these cannot be sold in the amounts required to make it economically viable to brew them in full sized batches, but can be quite profitable if produced efficiently in the low volumes for which a market is assured. Other items installed include a new wort vapour condenser, an insulated tank (to store the energy recovered by the condenser in the form of hot water) and a wort heater. This last is a heat exchanger that uses energy recovered from an earlier brew to preheat the wort of the current brew before boiling. In order to avoid generating more recoverable energy than can be used, the wort boiling process has been altered to reduce the evaporation rate (which before the refurbishment was about 10%). The optimum rate, from the viewpoint of energy efficiency, would be about 4.5%; by the time of writing, the average evaporation loss had been cut to about 5% without any detrimental effects on wort quality. The refurbishment cost about 400000 euros. At the time of installation, the reductions in both heat and electricity consumption achieved by the refurbishment were predicted to generate energy cost savings sufficient (at the prices then prevailing) to recover the whole sum invested within about 3 years.

Brauwelt, 8 July 2010, 150(27), 806-808

Click here to view record on Brew Lit

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Conclusions

• The brewing, distilling and malting industries have done well in reducing environmental footprints but plenty of opportunities remain.
• Carbon footprinting is a valid means to measure energy efficacy of the product lifecycle.
• Cogeneration is a viable option in some circumstances. Consider increasing energy prices and renewable fuel options.
• Thermal imaging may reveal inefficiencies and opportunities for energy economy in plants that would otherwise be missed.
• Water security may be an issue for some plants, poor water quality may affect wastage or effect shutdowns.
• Campden BRI have upgraded their free-to-access website to include case studies as well as technology suggestions.

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g.freeman@bri-advantage.com
a.johnson@bri-advantage.com

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