More Bacon with fewer Calories

Improving Energy Efficiency in Food Manufacturing

A presentation to...

Institute of Food Science + Technology ifst

by...

Rob Nugent
Operations Director

DIRECT TABLE Foods

Stephen McAuley
Managing Director

CROWLEY CARBON
COOLING THE PLANET

Units of Energy – Food & Power

1 kilocalorie = 0.001163 kWh

1 kWh = 860 kilocalories

100 Watt light bulb
10 Hours
= 1 kWh

860 kilocalorie
= 300g Bacon

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Driven by Bacon...

USA 2014:

Hormel Foods

created a custom motorcycle that runs on

100% refined bacon grease

and has a seat made of pigskin!

The bike was part of a marketing promotion for their Black Label Bacon.

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46,000 Tonnes – 11,300,000 kWhrs

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Direct Table Foods – Saxham Site

Phase 1 } **12,500m²**
Phase 2 }

G60 **5,500m²**

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Foods

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Foods

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Quality Certification

BMPA Quality Assured Bacon Scheme
(2 x annual inspections by SAI Global, including unannounced)

Red Tractor Licensed
(Inspected by SAI Global, incorporated into BMPA Scheme)

Danish Sizzle

BRC Standard Food Issue 7, Grade AA
(SAI Global)

Fair Working Conditions Ethical Audit

Soil Association Organic Certification
(Annual SA Cert inspection)

SEDEX Member

RSPCA Assured

Energy Efficiency

PROJECTS 2011 TO DATE:

- ✔ LED Lighting Retrofit
- ✔ Lighting Movement Sensors
- ✔ Electric Motor Controls
- ✔ Heat Recovery – Hot Water
- ✔ Heat Recovery – Office Heating
- ✔ C^3 Energy Management System
  - ✔ Including Water Metering

Carbon Emissions Reduction

HEAT RECOVERY

- ✔ **High pressure heat pump installed which utilises heat from refrigeration system to heat water for washdown to 65 degrees C with a COP of 6.2**
- ✔ **30,000 litres per day**
- ✔ **Payback circa 1 year**

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Heat Recovery (continued)

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LED Lighting

- ✔ **Retrofit programme**
- ✔ **Replace 935 6ft T8 77W with LED @ 27W**
- ✔ **Replace 89 5ft T8 64W with LED @ 20W**
- ✔ **Replace 864 2ft T8 40W with LED @ 18W**
- ✔ **Replace car park floodlight**
- ✔ **Replace roof void floodlight**

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LED Lighting (continued)

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Electric Motor Controls

- ✔ **Fixed speed motor controllers on vacuum pumps and compressors**

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Office Heating

- ✔ **Office central heating system powered by heat recovery from Thermal Server**
- ✔ **Option to convert to Ground Source**

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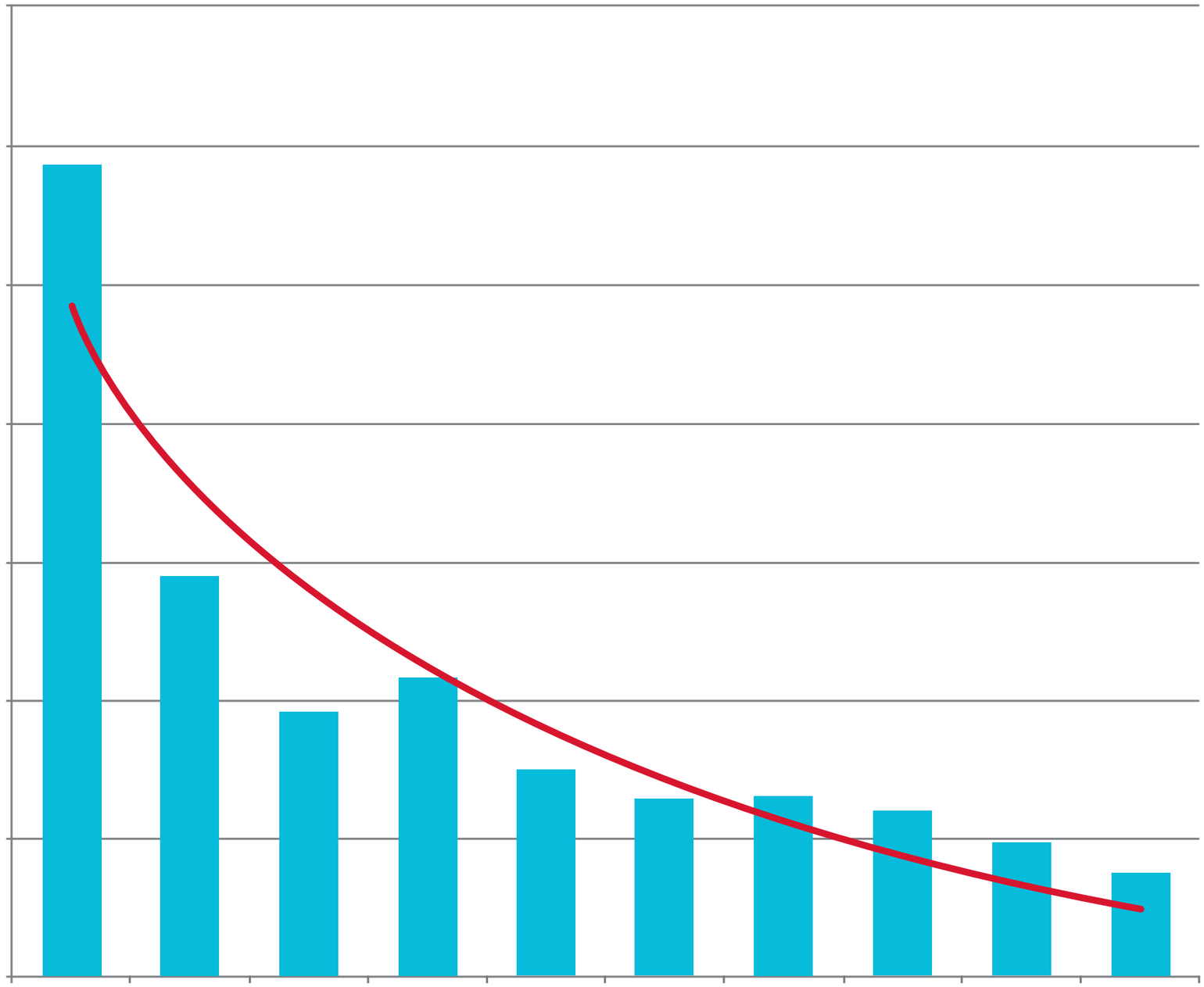
A decrease...



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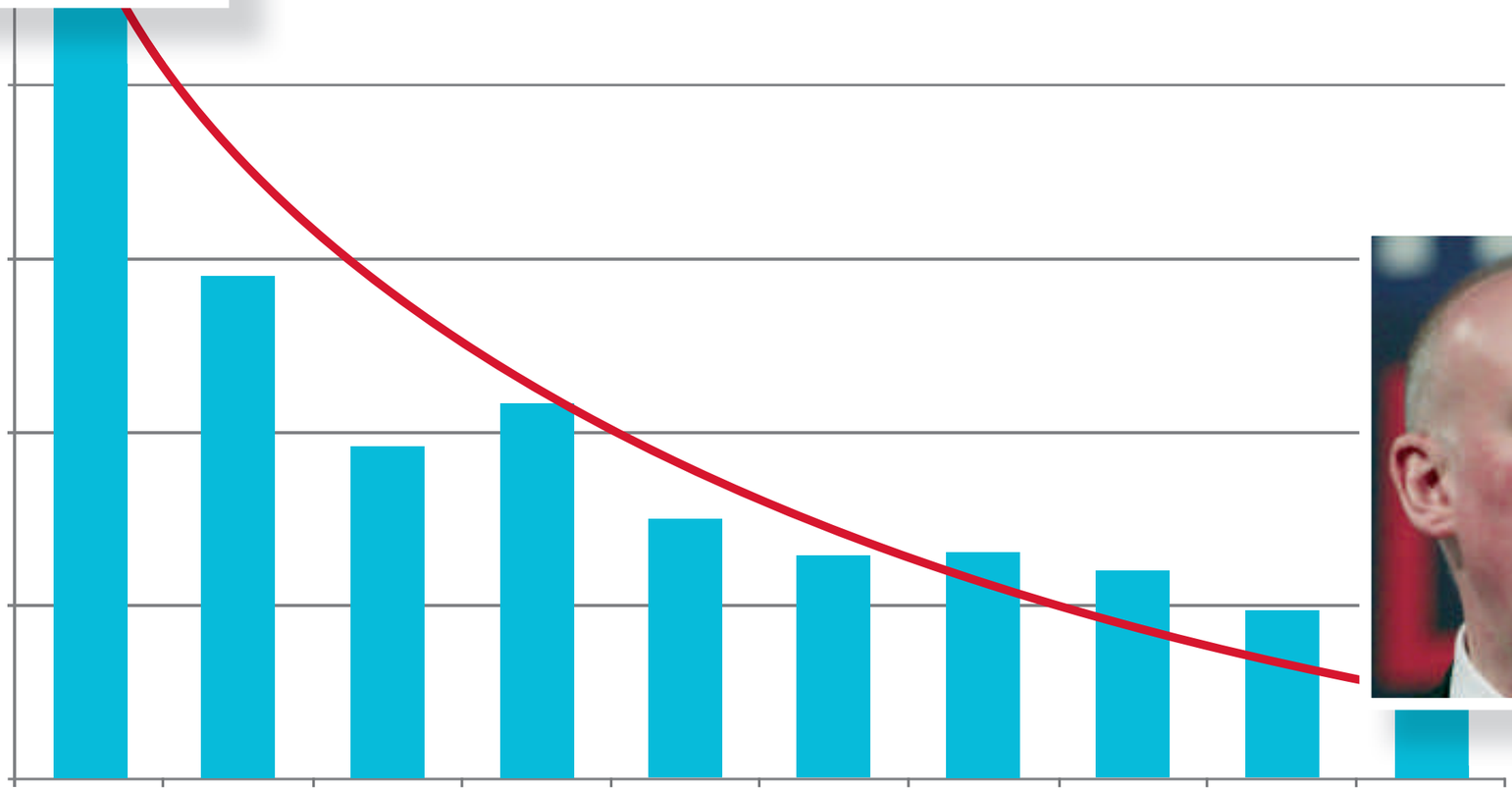
A decrease in hair...



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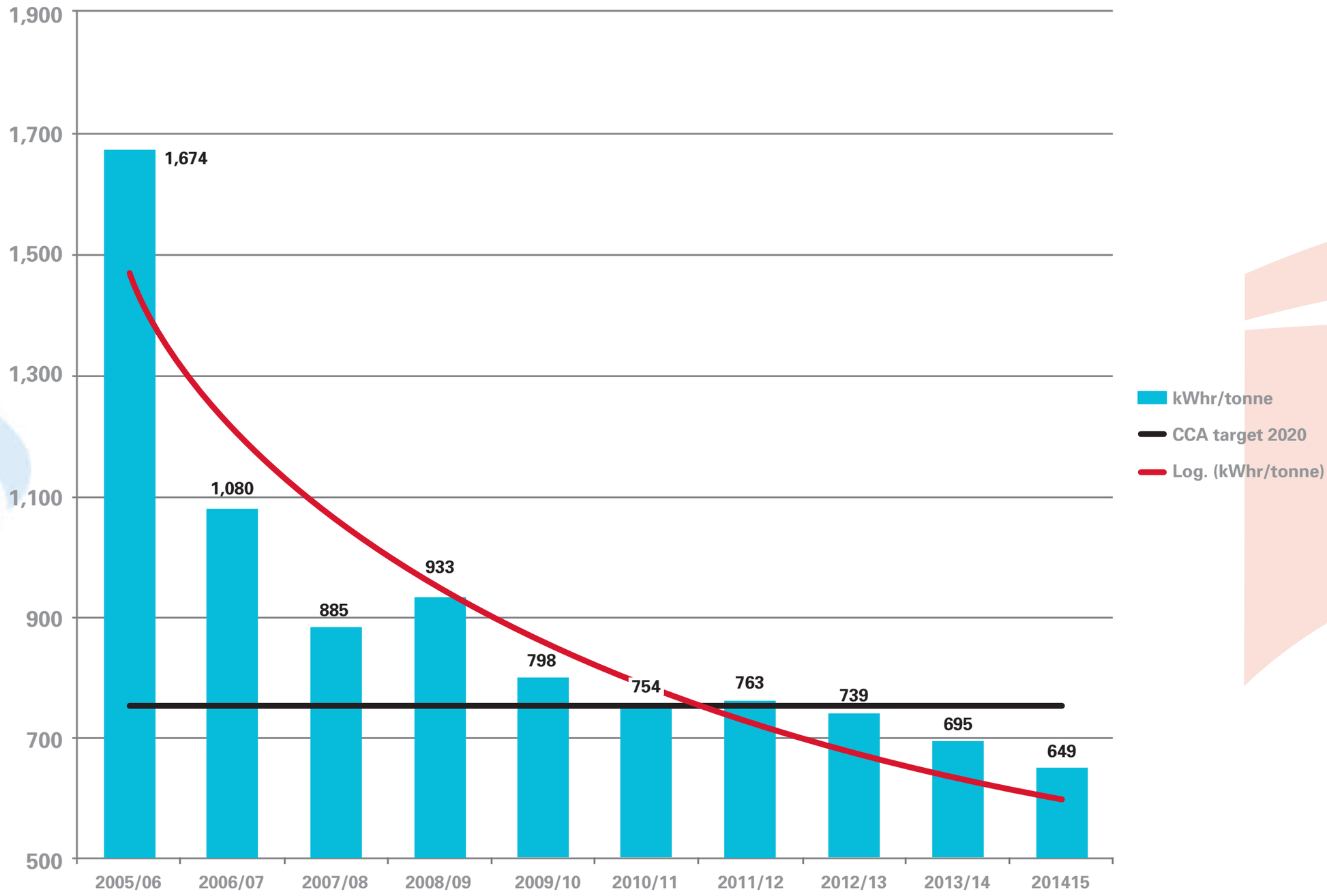
Energy Efficiency



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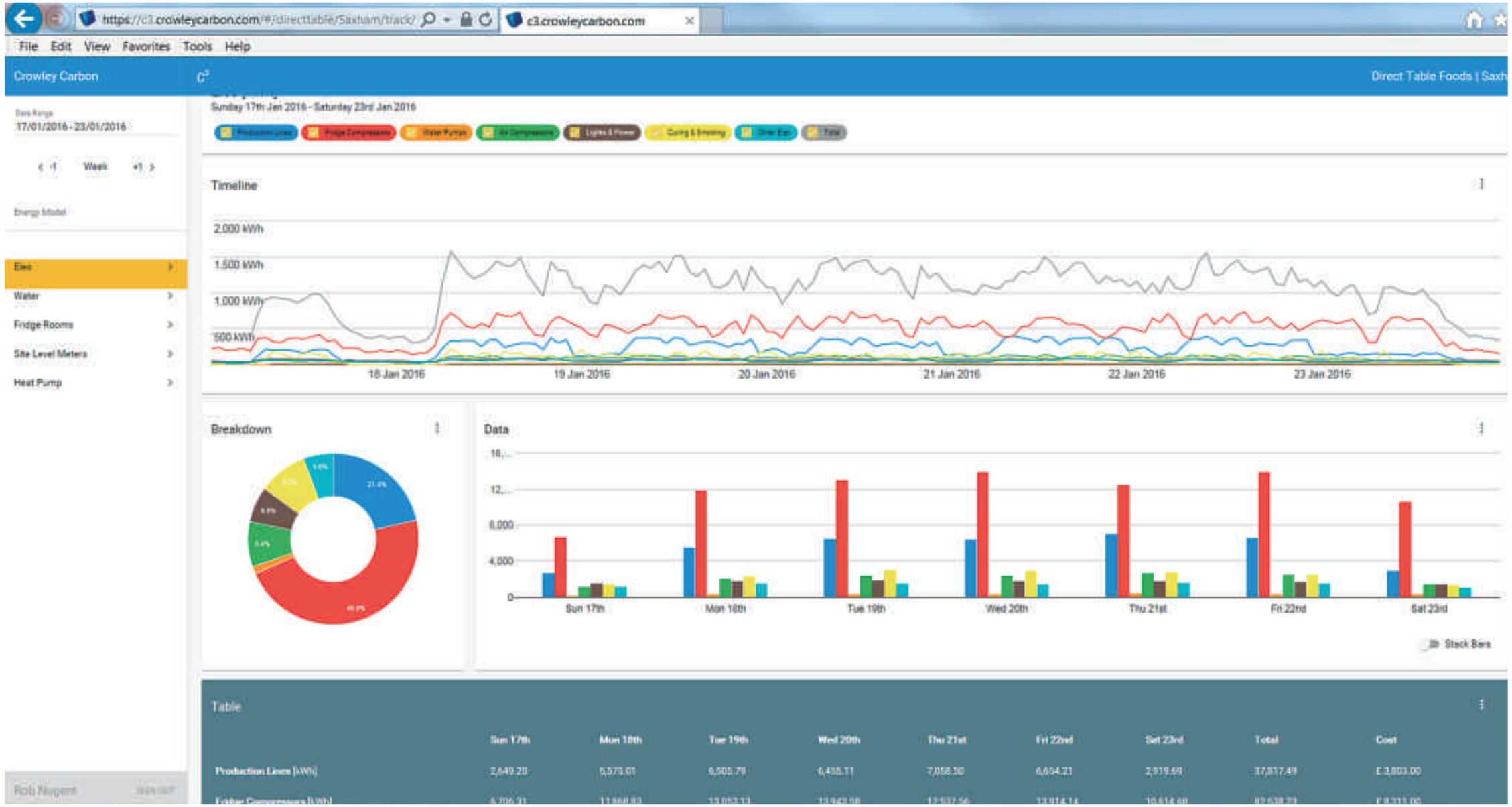
C³ Energy Management System



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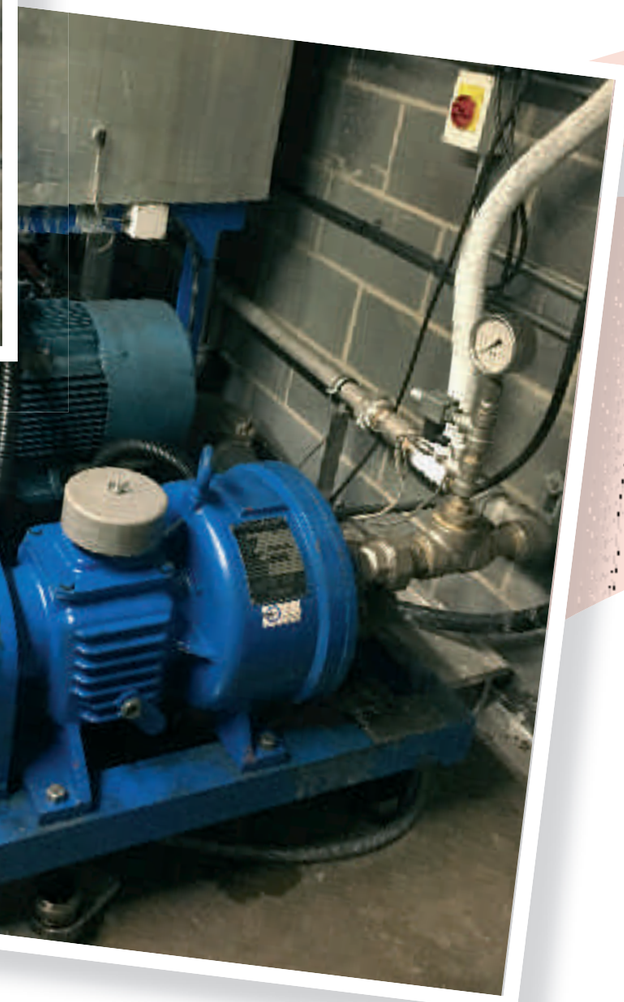

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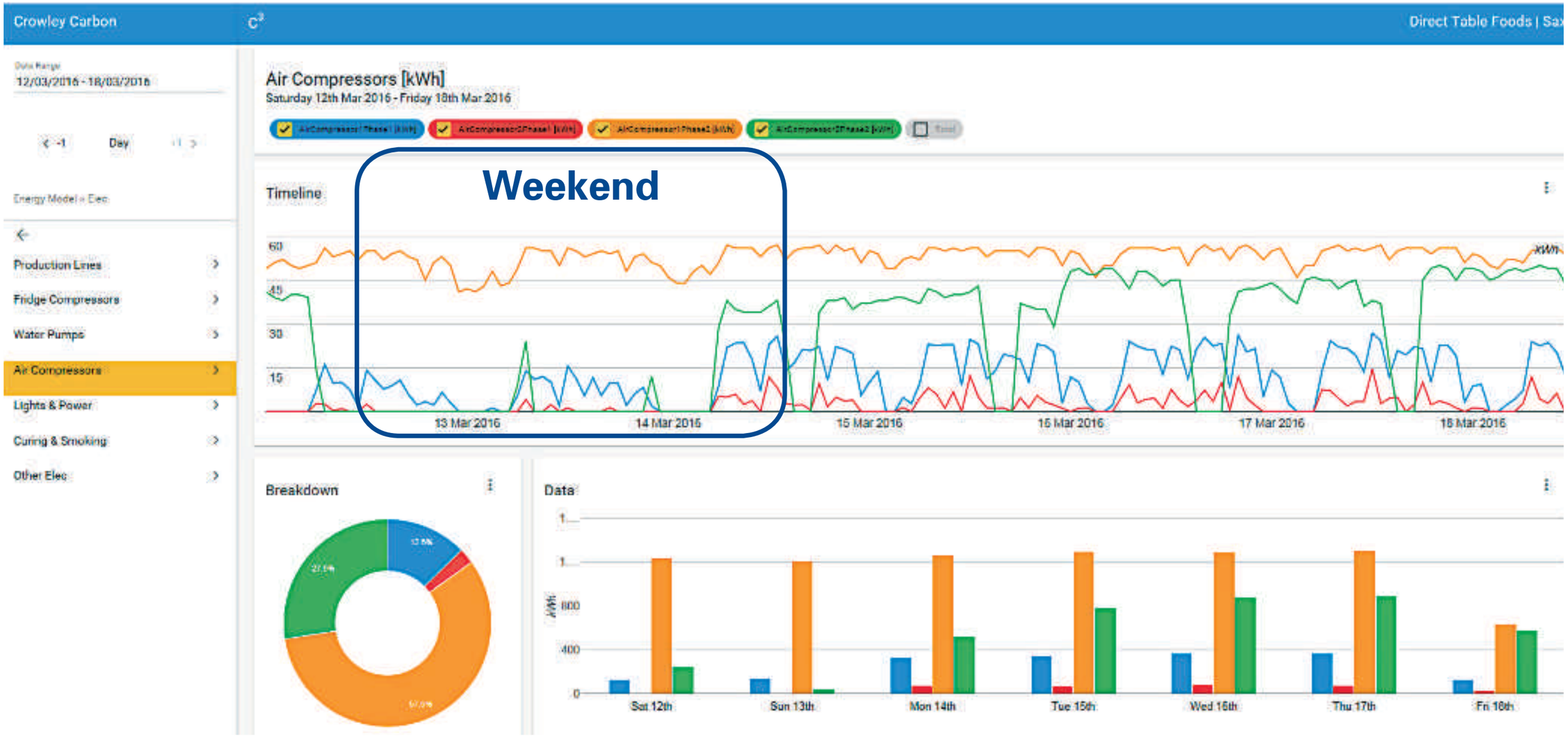
Air Compressors



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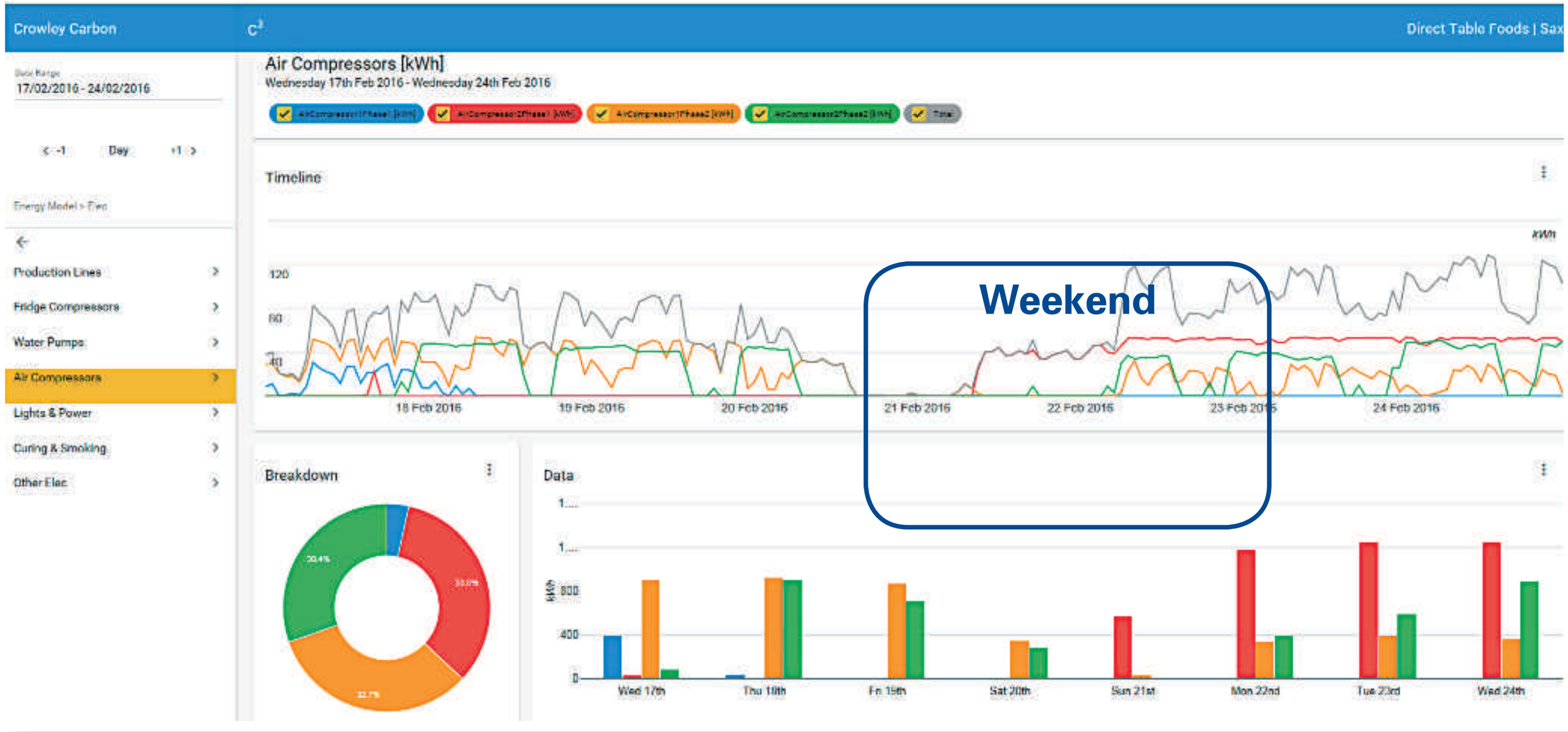
Air Compressors

Example of a weekend where we were able to turn the lead compressor off



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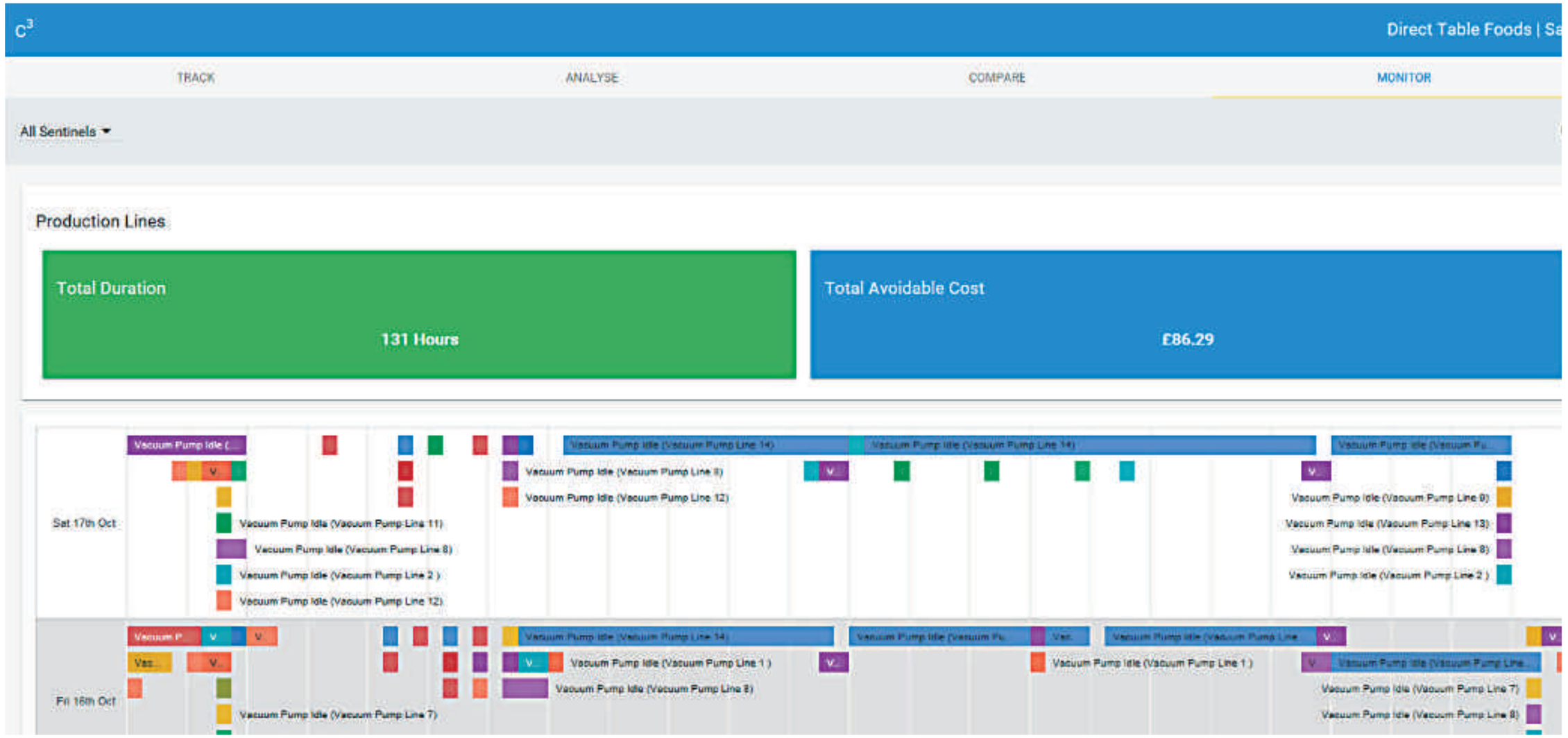
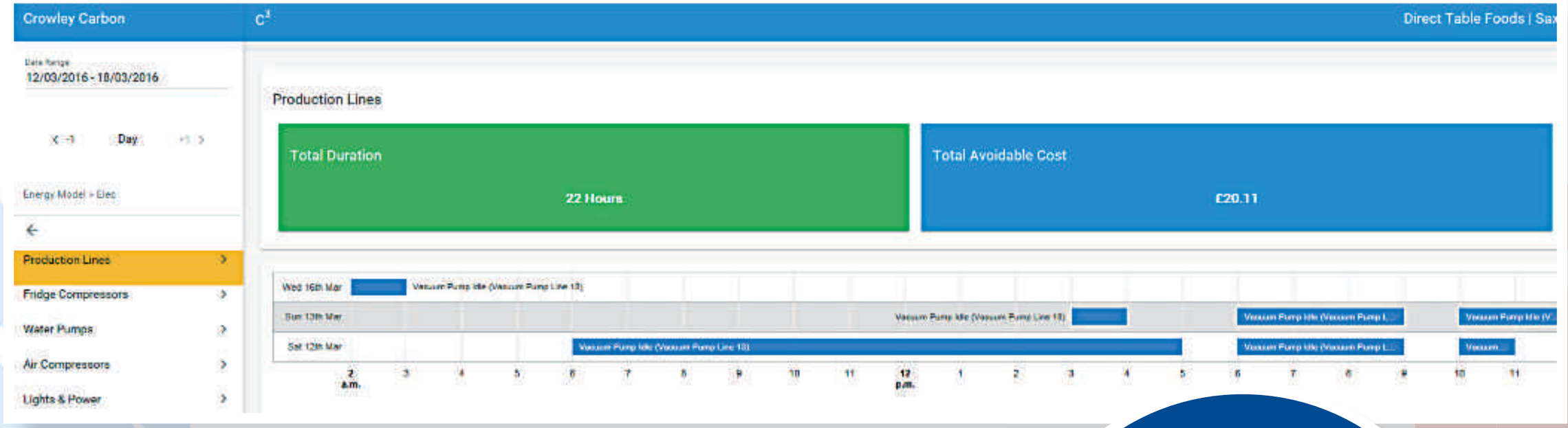
Air Compressors

- ✔ **Turned off between 13th Feb and 7:00am on 21st Feb**
- ✔ **In this week the running cost was £913 compared to last week's cost of £1459**
- ✔ **£546 weekly saving**
- ✔ **£28,392 annualised saving (assuming we continue to work weekends)**

Sentinels


C3
Direct Table Foods | Se
TRACK
ANALYSE
COMPARE
MONITOR
All Sentinels
Production Lines
Total Duration
131 Hours
Total Avoidable Cost
£86.29
Sat 17th Oct
Vacuum Pump Idle (Vacuum Pump Line 11)
Vacuum Pump Idle (Vacuum Pump Line 8)
Vacuum Pump Idle (Vacuum Pump Line 2)
Vacuum Pump Idle (Vacuum Pump Line 12)
Vacuum Pump Idle (Vacuum Pump Line 8)
Vacuum Pump Idle (Vacuum Pump Line 12)
Vacuum Pump Idle (Vacuum Pump Line 9)
Vacuum Pump Idle (Vacuum Pump Line 13)
Vacuum Pump Idle (Vacuum Pump Line 8)
Vacuum Pump Idle (Vacuum Pump Line 2)
Fri 16th Oct
Vacuum Pump Idle (Vacuum Pump Line 7)
Vacuum Pump Idle (Vacuum Pump Line 1)
Vacuum Pump Idle (Vacuum Pump Line 8)
Vacuum Pump Idle (Vacuum Pump Line 1)
Vacuum Pump Idle (Vacuum Pump Line 7)
Vacuum Pump Idle (Vacuum Pump Line 8)

Sentinels (continued)



11th Oct- 17th Oct= £86.16

6th Mar- 12th Mar= £20.11

£66.05

Annualised Saving = £3,434.60

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Water Pumps

Table

	Sat 12th	Sun 13th	Mon 14th	Tue 15th	Wed 16th	Thu 17th	Fri 18th	Total	Cost
HotWaterPumpsWashDown 1 [kWh] [kWh]	370.50	312.70	322.10	387.30	387.50	388.60	202.40	2,371.10	£ 238.00
HotWaterPumpsWashDown 2 [kWh] [kWh]	40.00	37.00	39.10	43.30	42.20	41.50	23.90	267.00	£ 27.00
Totals [kWh]	410.50	349.70	361.20	430.60	429.70	430.10	226.30	2,638.10	£ 265.00

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Water Pumps (continued)

Weekly cost = £265

Annual Cost = £13,780

- ✔ **Continually running?**
- ✔ **Insert timers to reduce usage**
- ✔ **A small target of 20% reduction will save £2756 p/a**

Crowley Carbon Overview

- ✔ **Broad spectrum Energy Efficiency and Services Company**
  - ✔ **Specification and Design**
  - ✔ **Project Management**
  - ✔ **New product development and manufacture**
  - ✔ **Financing – Energy Performance Contracting**
- ✔ **Focus on Large Commercial and Industrial businesses**
- ✔ **Patents in the areas of waste heat to electricity, contaminated heat recovery and fossil fuel fired heat pumps, evaporative cooling and ACC**
- ✔ **Operations in Ireland, UK, UAE and Australia**

What does a tonne of CO^2 look like?

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One tonne of CO^2 is about the same volume as a 3 bedroomed semi detached house

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Crowley Carbon have reduced customers carbon footprint by

795,562

tonnes of CO^2

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Some Crowley Carbon Clients

BAKKAVÖR

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Young's SEAFOOD LIMITED

tican

Bernard Matthews

vodafone

BENTLEY

Irish Distillers Pernod Ricard

rosderra IRISH MEATS

intel

carillion

MUSGRAVE GROUP

TAYTO

JAGUAR

DAWN MEATS

MISSION

Ingersoll Rand

Hunky Dorys

2 sisters Food Group

CRANSWICK plc

VAUXHALL Raising the Standard

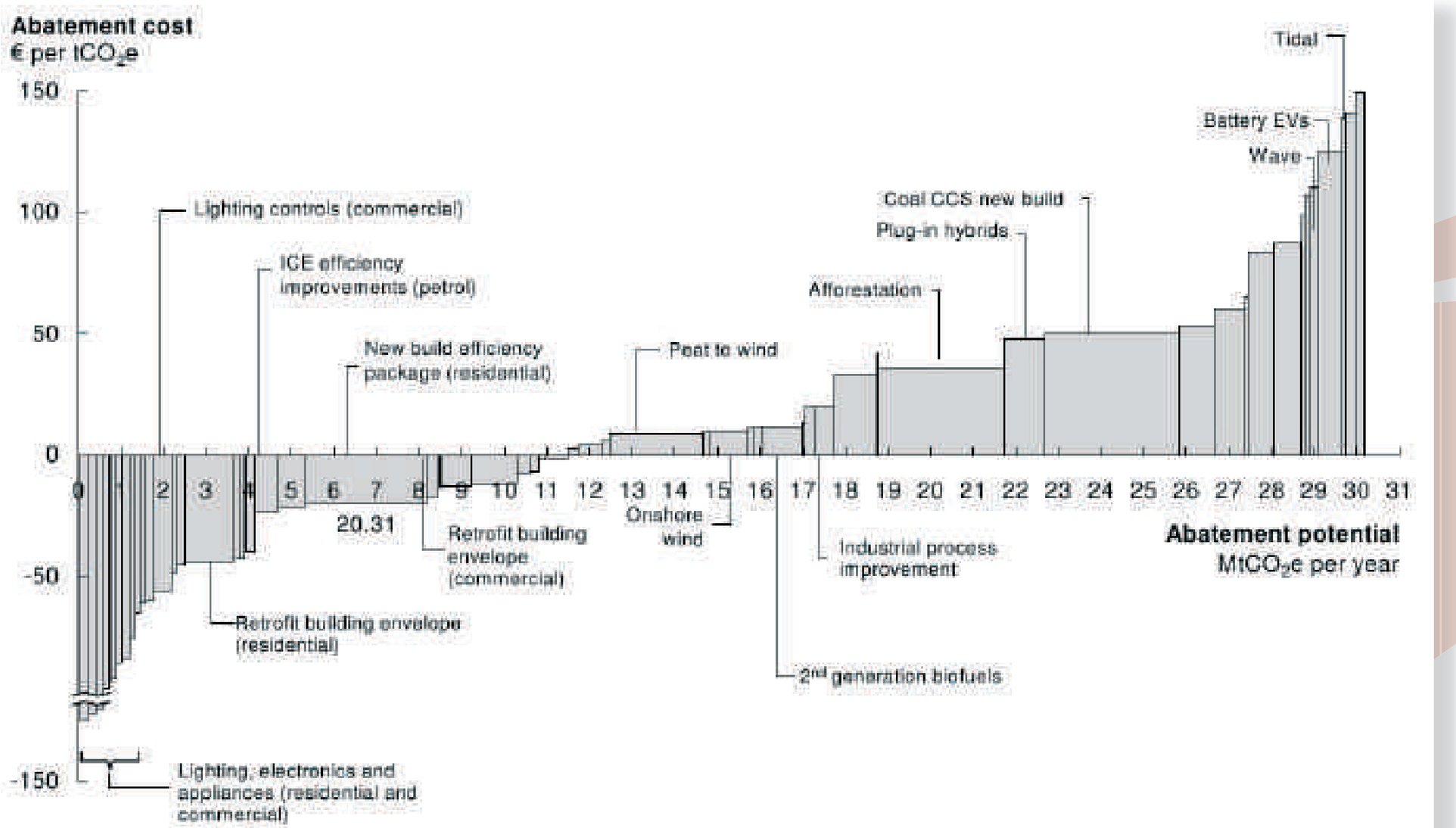
QinetiQ

Pfizer

EMRILL Integrated Facilities Management

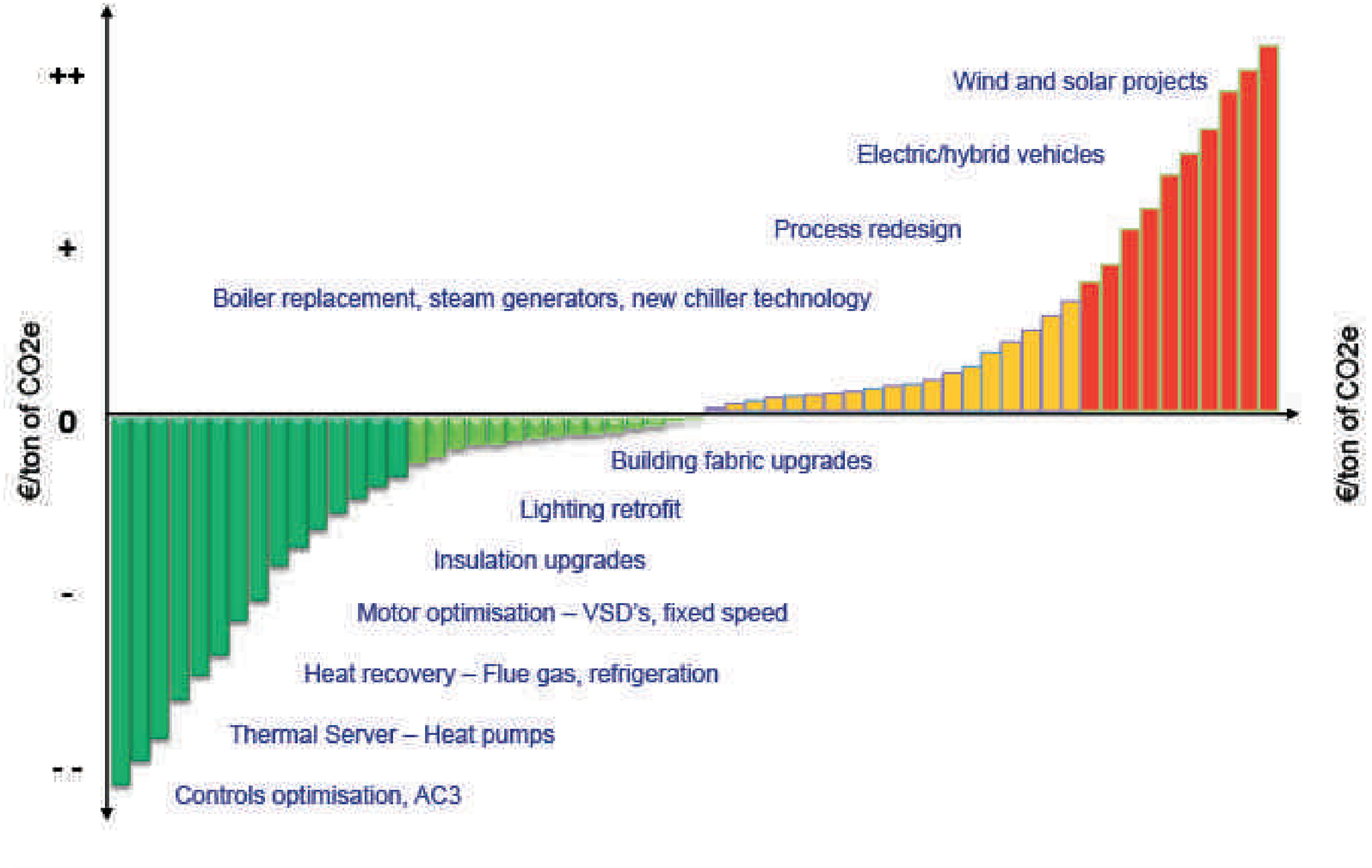
Johnson & Johnson

Mckinsey Carbon Abatement Curve



1 Baseline cost curve based on 2007 IEA energy price forecasts (~60 USD / barrel in 2030) and a real cost of capital of 4%

Crowley Carbon Industrial Carbon Abatement Curve



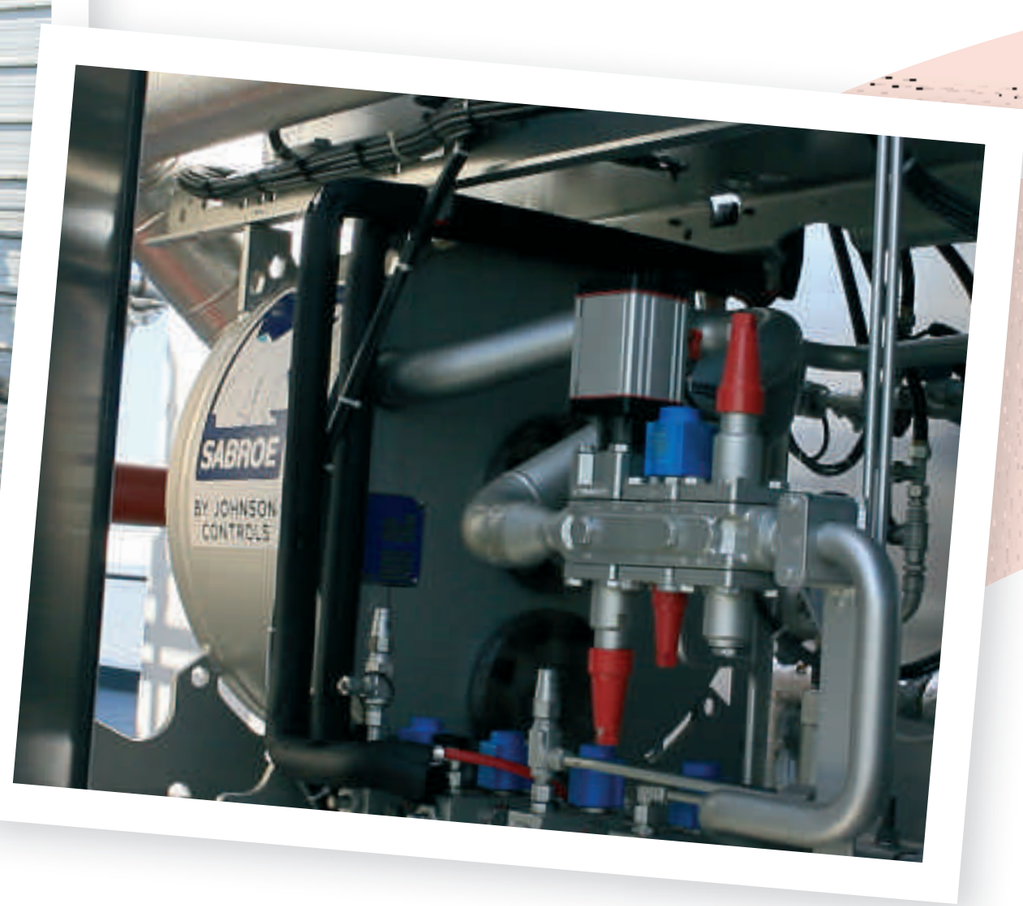
What do we deliver?

- ✔ **Objective is to deliver 30% savings**
- ✔ **Payback always less than 3 years**
- ✔ **Savings guaranteed**
- ✔ **Savings underwritten by MunichRe (second largest insurance company in the World)**
- ✔ **Funding**

What is the RHI?

- ✔ **A government incentive to encourage the use of Renewable Heat technologies**
- ✔ **Technologies covered include:**
  - ✔ Biomass boilers
  - ✔ Solar Thermal
  - ✔ Heat pumps
- ✔ **The system works similar to a feed in tariff where, for every KWth generated, Ofgem pay a subsidy**
- ✔ **The subsidy ranges from 1.5p to 9p depending on the technology**
- ✔ **For ground source water heating the subsidy ranges from 8.9p to 3p**
- ✔ **This subsidy will be paid for 20 years from date of commissioning of project**

Thermal Server



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RHI Financials

- ✔ **This technology requires ground source heat from either an open or closed loop system**
- ✔ **Open system is lower cost but it will involve extracting circa 60 M3 of water from ground source per hour**

KW used on water heating	250.00
KW used pr annum @ 7300 hours	1,825,000
Spend per annum on hot water with 85% efficiency boiler	£54,750
KW used per hour	250.00
Cost of heating water	£2.50
Normal cost to heat water	£10.00
Nett saving to heat water per hour	£7.50
Annual savings to heat water	**£36,500**
Value of RHI per hour @ 3.5p per kWh	£8.75
Value of RHI per year	**£76,650**
Upside per annum from RHI and Energy Savings	**£113,150**

Why C³ – “Because machines keep secrets”

"I’m way too big for this job – I waste most of my fuel!"

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Why C³ – “Because machines keep secrets”

"I don't need to run at all!!"

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Why C³ – Nobody can listen to all this noise!

My boilers and my chillers spend all day fighting each other!

My boilers and my chillers spend all day fighting each other!

My boilers and my chillers spend all day fighting each other!

My boilers and my chillers spend all day fighting each other!

My boilers and my chillers spend all day fighting each other!

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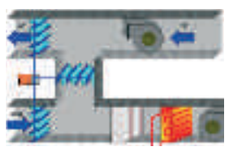
Normal Energy Management System – Adding to the noise

ENERGY MANAGEMENT SYSTEM

MCC

MCC



C³ CARBON CONTROL CENTRE

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Carbon Control Centre

Function | **Context** | **Condition** | **Control**

CARBON CONTROL CENTRE

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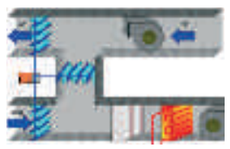

MCC

Key Energy Drivers based on production process and energy consumption

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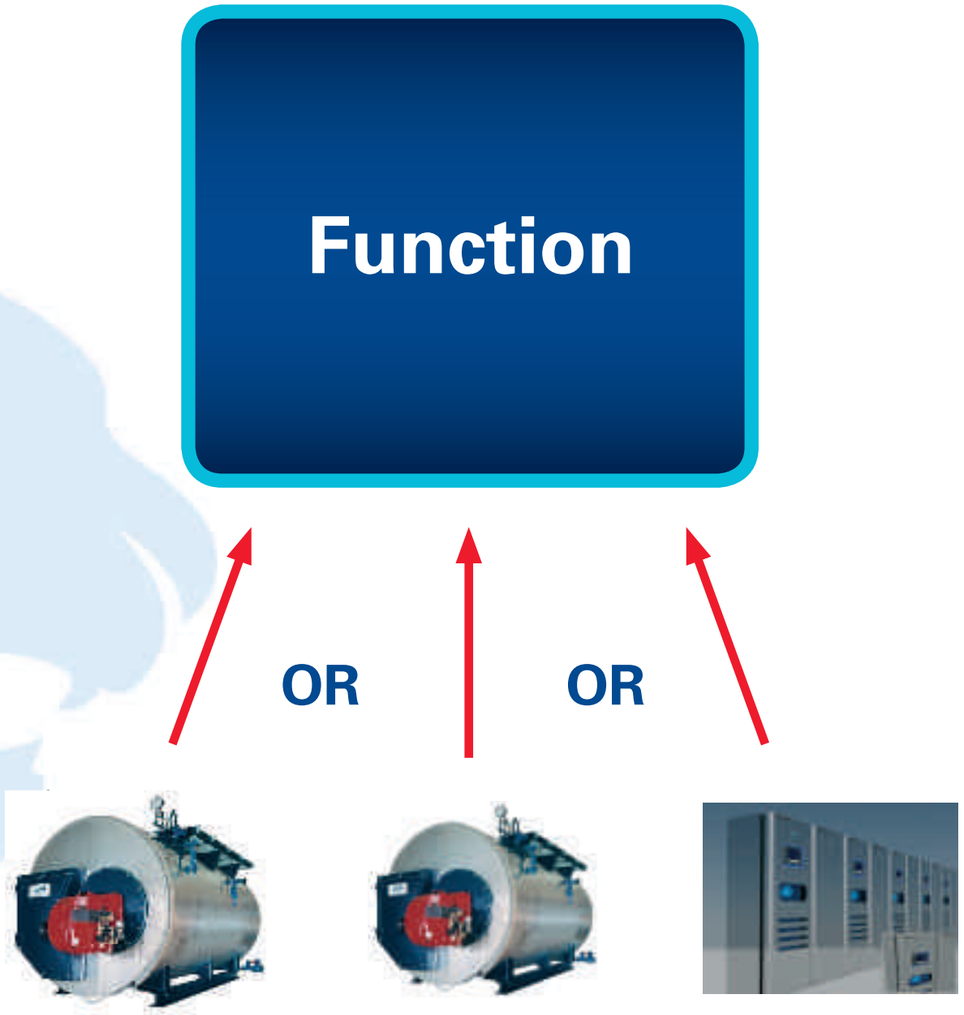
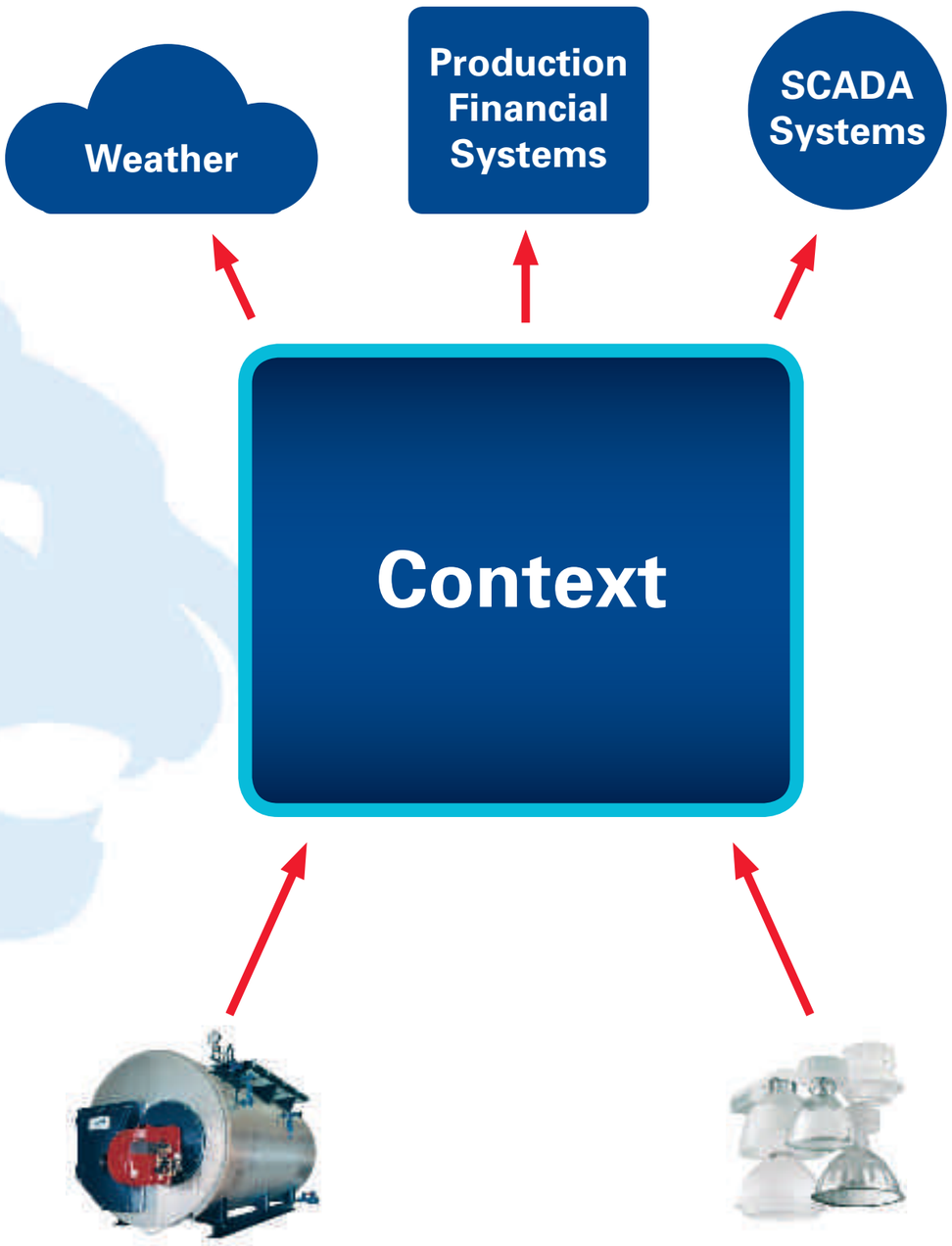
COOLING THE PLANET

Carbon Control Centre – Function



- ✔ **The wrong piece of equipment can waste up to 80% of the energy consumed e.g.**
  - ✔ **Steam boiler for heating water**
  - ✔ **Boiler too large etc.**
- ✔ **Is this piece of equipment correct for this job**
- ✔ **Should a smaller machine be used or a different machine entirely**
- ✔ **The C^3 Solutions Design Team understands the production process and then checks from a database of over 8000 pieces of equipment to recommend the optimal solution**

Carbon Control Centre – Context



- ✔ **Energy Information on its own has limited value**
- ✔ **Dynamically linking this information to external data sources provides a powerful decision making tool**
- ✔ **Links to;**
  - ✔ **ERP**
  - ✔ **Financial**
  - ✔ **SCADA**
  - ✔ **Weather**
- ✔ **C^3 Context Engine uses a powerful business intelligence tool to match energy data to key production**

Carbon Control Centre – Condition

Condition

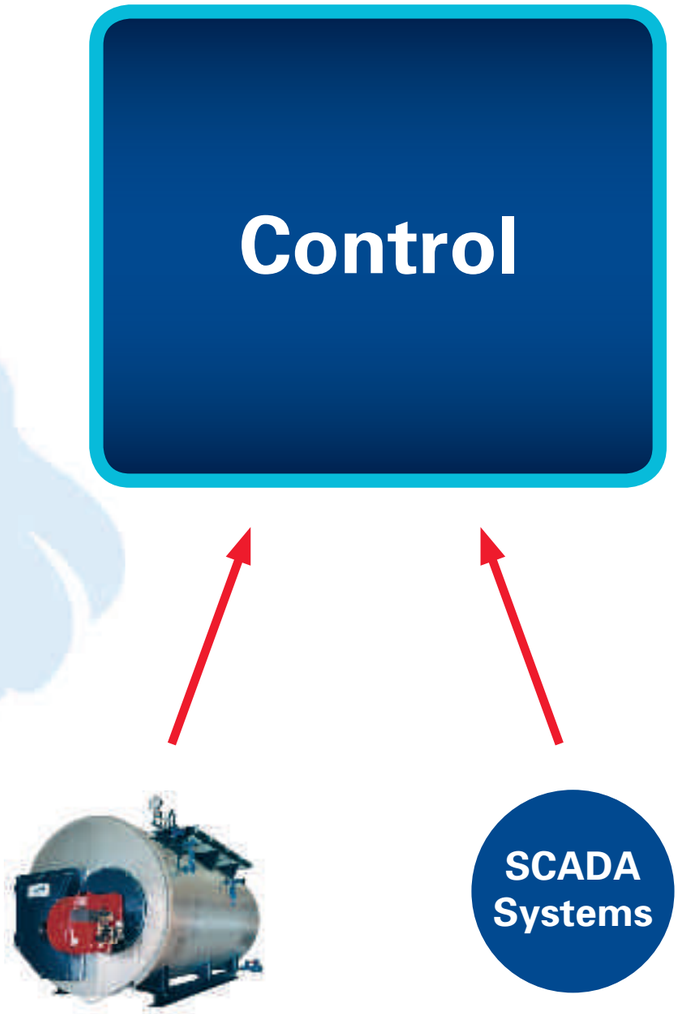
- ✔ **We don’t just gather kWh we can also detect;**
  - ✔ **Vibration**
  - ✔ **Flood detection**
  - ✔ **Cycling and hunting**
  - ✔ **Pumps Cavitating**
  - ✔ **Poor Power Factor**
- ✔ **This knowledge saves energy but also reduces risk to the process and extends equipment life**

Spark Sample

ValleyPark

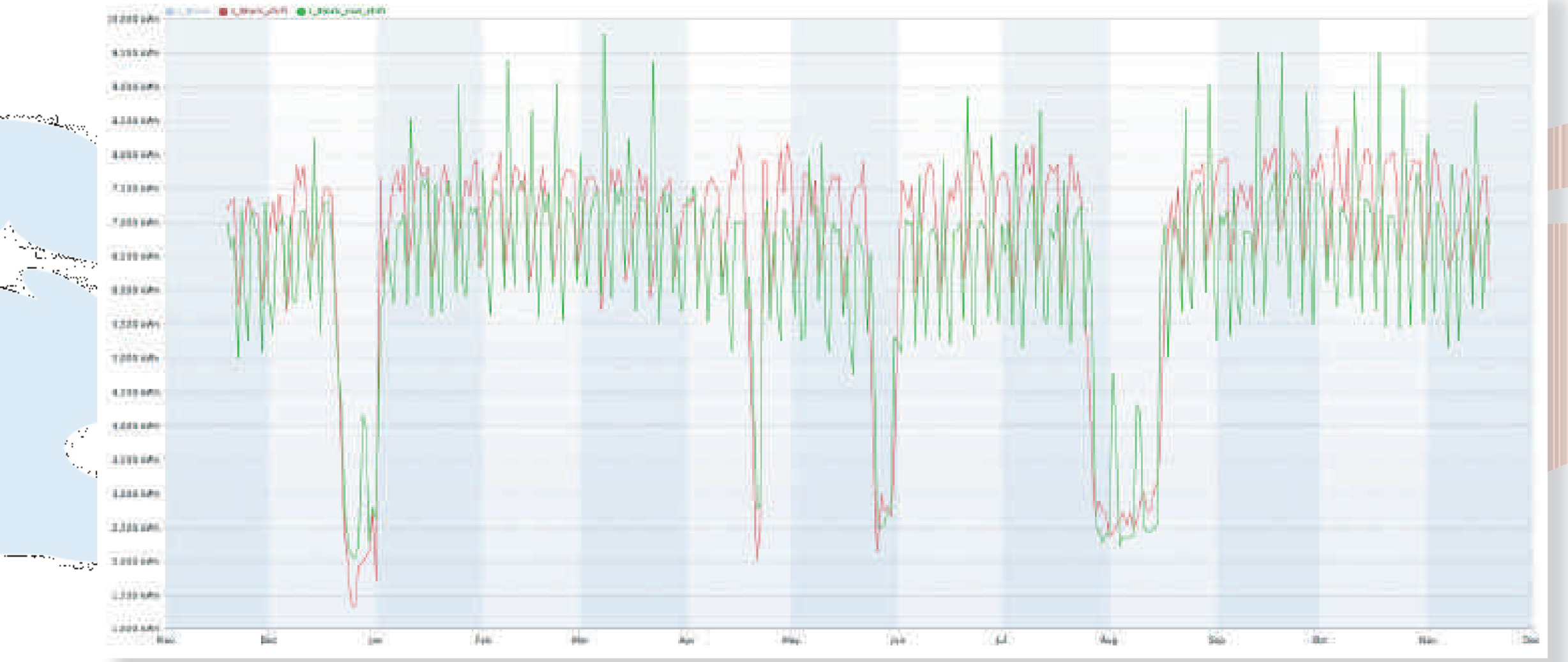
Date:	3-May-2015
Target:	Vacuum Pumps
Rule:	Vacuum Pumps when LT Fridge Off
Site:	ValleyPark
Equip:	Vacuum Pumps
Cost:	73£
Dur:	14hr
Times:	12:00a (3hr), 1:00p (11hr)
Tz:	London
Help:	Rule to find periods when Vacuum pumps are running but LT Fridge total is near 0.

Carbon Control Centre – Control



- ✔ **The C³ Platform contains a full control suite that is deployed in over 300,000 locations world wide**
- ✔ **Provided by Honeywell, the system talks 17 industrial languages including Bacnet, Modbus and Lon Works**
- ✔ **The system can control everything from CCTV to major process equipment and systems**
- ✔ **This control suite has been proven to cost less and provide more flexibility than any other system on the market**

Shift Pattern Sentinel



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Carbon Control Centre

- ✔ **Real time system monitoring from our Carbon Control Centre**
- ✔ **Using Automated Continuous Commissioning (ACC) technology**
- ✔ **Artificial Intelligence technology to predict issues with the site**
- ✔ **Real time reporting of issues to site engineering team**

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Carbon Control Centre – Online Management and Oversight

Function | **Context** | **Condition** | **Control**

CARBON CONTROL CENTRE

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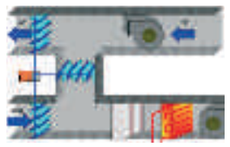

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Ambient Optimisation

- ✔ **Weather aware digital floating SAD (Suction, Ambient, Discharge) setpoint control (The AO application automatically balances energy consumption and critical setpoints)**
- ✔ **AO can also change setpoints to lower running cost at premium priced energy times and also when shifts are complete**
- ✔ **Manages sequencing of compressors to ensure that most efficient compressor is used at all times**
- ✔ **Monitors power factor and uses fixed speed motor control to achieve further savings**

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Other Benefits...

- ✔ **Doubles the useful life of most refrigeration equipment**
- ✔ **Lowers maintenance costs**
- ✔ **No programming required by maintenance staff**
- ✔ **Can be monitored using any web browser, smartphone or PDA**
- ✔ **Reduces needless refrigeration call outs**
- ✔ **Integrates to existing SCADA equipment**

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Clients of AO

- ✔ Bernard Matthews
- ✔ Cranswick Group
- ✔ Dawn Meats Group
- ✔ Linden Foods
- ✔ Tennents Lager
- ✔ Jaguar Landrover
- ✔ Johnson & Johnson
- ✔ GE Healthcare
- ✔ Direct Table Foods

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Case Study 1

- ✔ **Large food company with 27 factories across Ireland, UK and South Africa**
- ✔ **Heat recovery from contaminated steam using a superconducting heat recovery system**
- ✔ **First of its kind in the world**
- ✔ **How water was piped over 1KM to sister factory**
- ✔ **Fully automated solution installed**

Results:

Savings:	**€640,000**
Capital Costs:	**€1,022,000**

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Case Study 2

- ✔ **UK Producer of processed bacon for UK supermarkets**
- ✔ **High pressure heat pump installed which utilises heat from refrigeration system and increases temperature to 65 degrees C with a COP of 6.2**
- ✔ **LED lighting retrofit to entire plant**
- ✔ **Motor controls system installed across entire plant**

Results:

Savings:	**£472,000**
Capital Costs:	**£977,000**

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Case Study 3

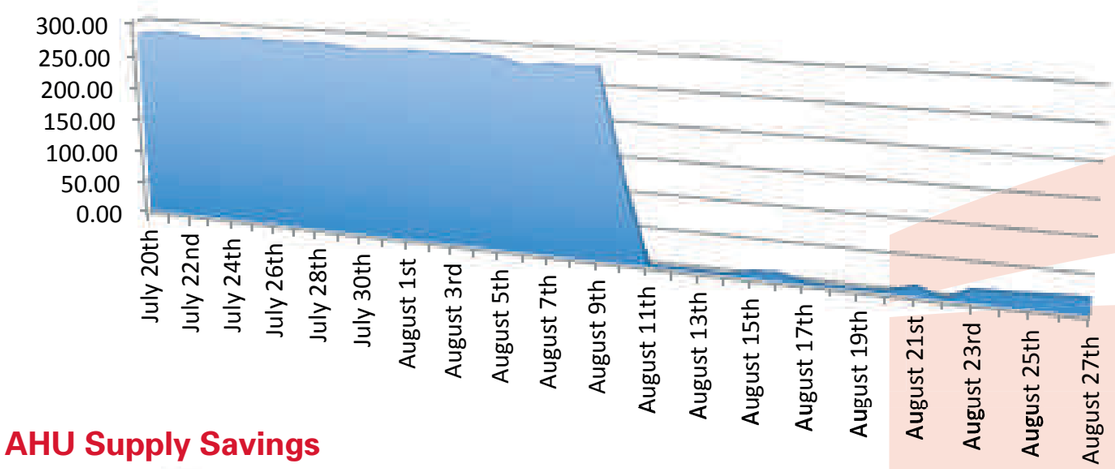
- ✔ **UK Government offices with over 6500 employees**
- ✔ **Redesign of the control systems**
- ✔ **Implement new controls system**
- ✔ **Implement Automated Continuous Commissioning (ACC)**
- ✔ **Implement motor/fan and pump control**

Results:

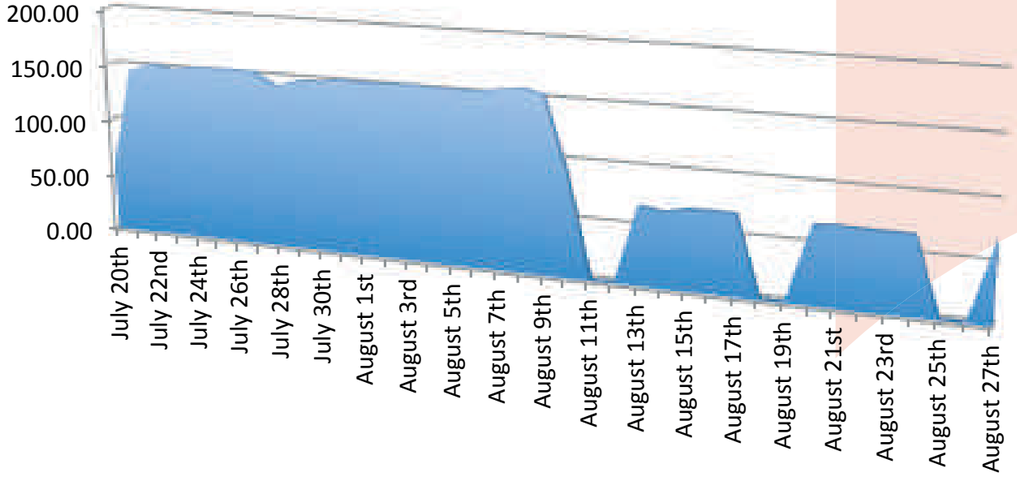
Savings: **£265,000**

Capital Costs: **£122,000**

Low Temp Hot Water Savings



AHU Supply Savings



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Case Study 4

- ✔ Over 80 facilities around the globe
- ✔ Manufacturers of compressors, refrigeration systems and other industrial products
- ✔ Project result:
  - ✔ Energy reduction of 55%
  - ✔ Lux level on the work plane improved by 30%
  - ✔ Colour temperature raised from 3000 to 6000 kelvin
- ✔ Technology used – Induction and LED

Savings: **€297,000**

Capital Costs: **€478,000**

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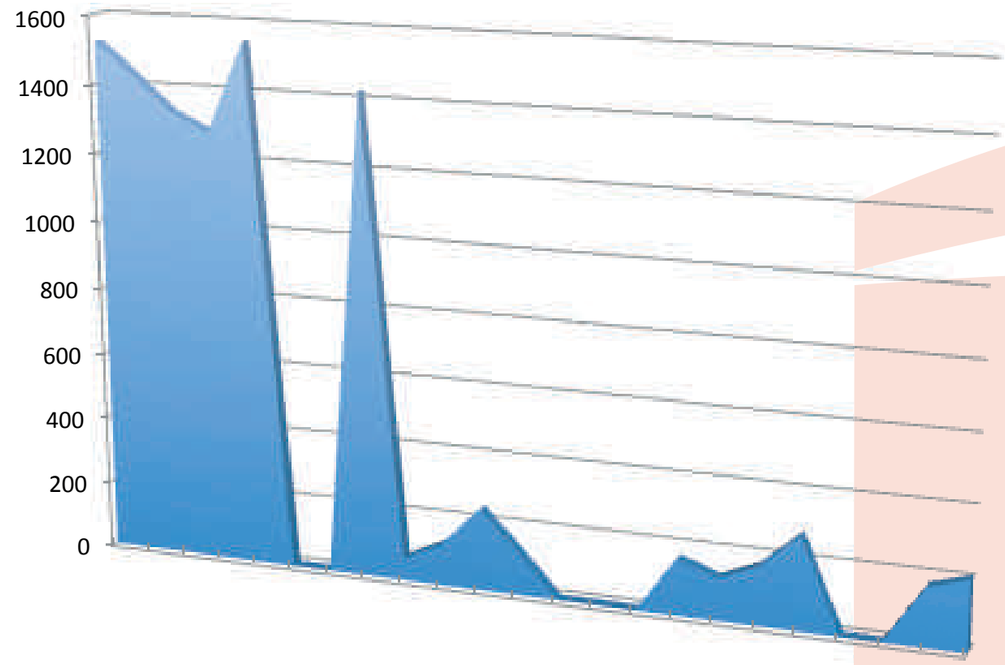
Case Study 5

- ✔ **Large food producer with locations in the UK and Ireland**
- ✔ **Major retrofit of technologies including;**
  - ✔ **Led and Induction lighting**
  - ✔ **Heat recovery from cooking flues**
  - ✔ **Heat recovery from Refrigeration Systems**
  - ✔ **High pressure heat pumps**
  - ✔ **Replacement of wash systems**
  - ✔ **Controls retrofit**
  - ✔ **Automated continuous commissioning**



Results:

Over £1,235,000 in energy saved

Capital Costs: £2,485,000

DIRECT TABLE Foods

CROWLEY CARBON
COOLING THE PLANET

Case Study 6

- ✔ **Large university campus with over 20,000 students and 34 buildings**
- ✔ **Major retrofit of technologies including;**
  - ✔ **Led and Induction lighting**
  - ✔ **New expert CHP control system which manages the start/stop of 6 CHP's**
  - ✔ **CHP consolidation – Linked the heat systems of CHP's to provide district heating system and reduce boiler gas consumption**
  - ✔ **Insulation replacement**
  - ✔ **New control philosophy**

Results:

Over €381,000 in energy saved

Capital Costs: **€383,000**

DIRECT TABLE Foods

CROWLEY CARBON
COOLING THE PLANET

Case Study 7

- ✔ Large Headquarters Building
- ✔ 3200 workers
- ✔ Introduction of Automated Continuous Commissioning
- ✔ New Smart Building Control Philosophy
- ✔ Redesign of existing heating and cooling infrastructure
- ✔ Introduction of solar chimney to cool main atrium
- ✔ Chiller retrofit

Results:

Savings:	**€230,000**
Capital Costs:	**€631,000**

DIRECT TABLE Foods

CROWLEY CARBON
COOLING THE PLANET

Products Developed by Crowley Carbon

- ✔ **Thermal Server**
  - ✔ Heat water up to 90 degrees
  - ✔ 4 times more efficient than industrial boiler
- ✔ **Superconducting heat recovery**
  - ✔ User superconducting heat pipes to recover heat with low pressure drop and from heavily contaminated heat sources
- ✔ **Automated Continuous Commissioning**
  - ✔ Uses Artificial Intelligence software to diagnose energy losses in manufacturing and HVAC systems
- ✔ **Fixed speed motor controllers**
  - ✔ Reduce energy in motors than can not have VSD's installed
- ✔ **PRV Turbines**
  - ✔ Captures kinetic energy from steam pressure reducing valves and uses it to generate electricity

DIRECT TABLE Foods

CROWLEY CARBON
COOLING THE PLANET

Your Savings Are Secured And Insured

- ✔ **Munich RE is our approved insurer**
- ✔ **5yr policy covering**
- ✔ **Material damage**
  - ✔ **Covers physical damage, including breakdown to equipment and material installed as part of an energy saving project. Replacing on a new for old basis**
- ✔ **Business interruption**
  - ✔ **Covers loss of gross revenue and increase cost of working following insured damage to equipment**
- ✔ **Asset performance**
  - ✔ **Covers the annual shortfall in energy savings compared to the amount of savings insured in the policy. Covers shortfall caused by design or implementation deficiencies of energy saving measures**

DIRECT TABLE Foods

CROWLEY CARBON
COOLING THE PLANET

Our Process

- ✔ **Introductory meeting**
- ✔ **Walk through audit**
- ✔ **Presentation on energy blueprint for the business, what we can achieve and the payback – no charge**
- ✔ **Your decision to proceed or not**
- ✔ **Engineering study (IGA)**
- ✔ **Fully costed, planned and funded solution**
- ✔ **Project manage the delivery of the savings within the payback – all guaranteed**