‘Developing and preparing a business case for a biomass heat project

Neil Harrison,

Re:heat and vice Chair of the WHA

Developing a Business Case for Biomass Heat

APSE Biomass Event
Manchester

Neil Harrison

Company established in 2011, but with a pedigree going back to 2003;

Business is a hybrid of consultancy, distributor, developer and installer;

Consultancy is fastest growing arm of the business, with due diligence, remedial reports, troubleshooting, legal commissions and strategic planning dominating;

Team of 7 staff, operating from Northumberland and Glasgow, but working across the UK (and beyond).

Why do we want to do this?

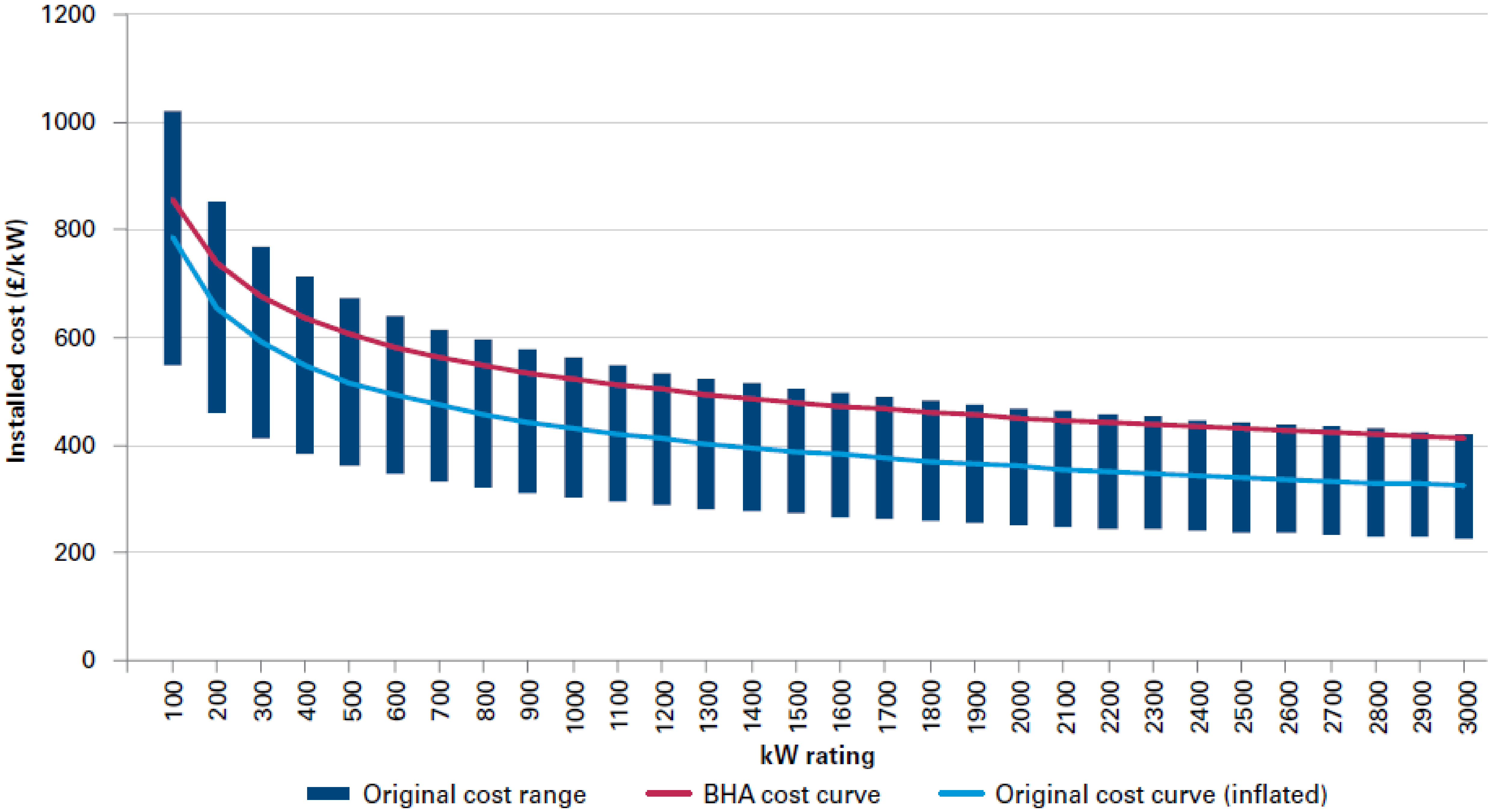
There are a wide range of reasons to want to progress with biomass heating - some or all of which may be part of your organisations’ motivation;

Understanding organisational motivation is the first step in building a business case - *winning hearts and minds*;

Primary	Secondary
Revenue generation/cost savings	“Right thing to do”
Carbon reduction targets	Local leadership
Replacement of ageing plant	Personal convictions of staff
Addressing air quality issues	Anticipating legislative

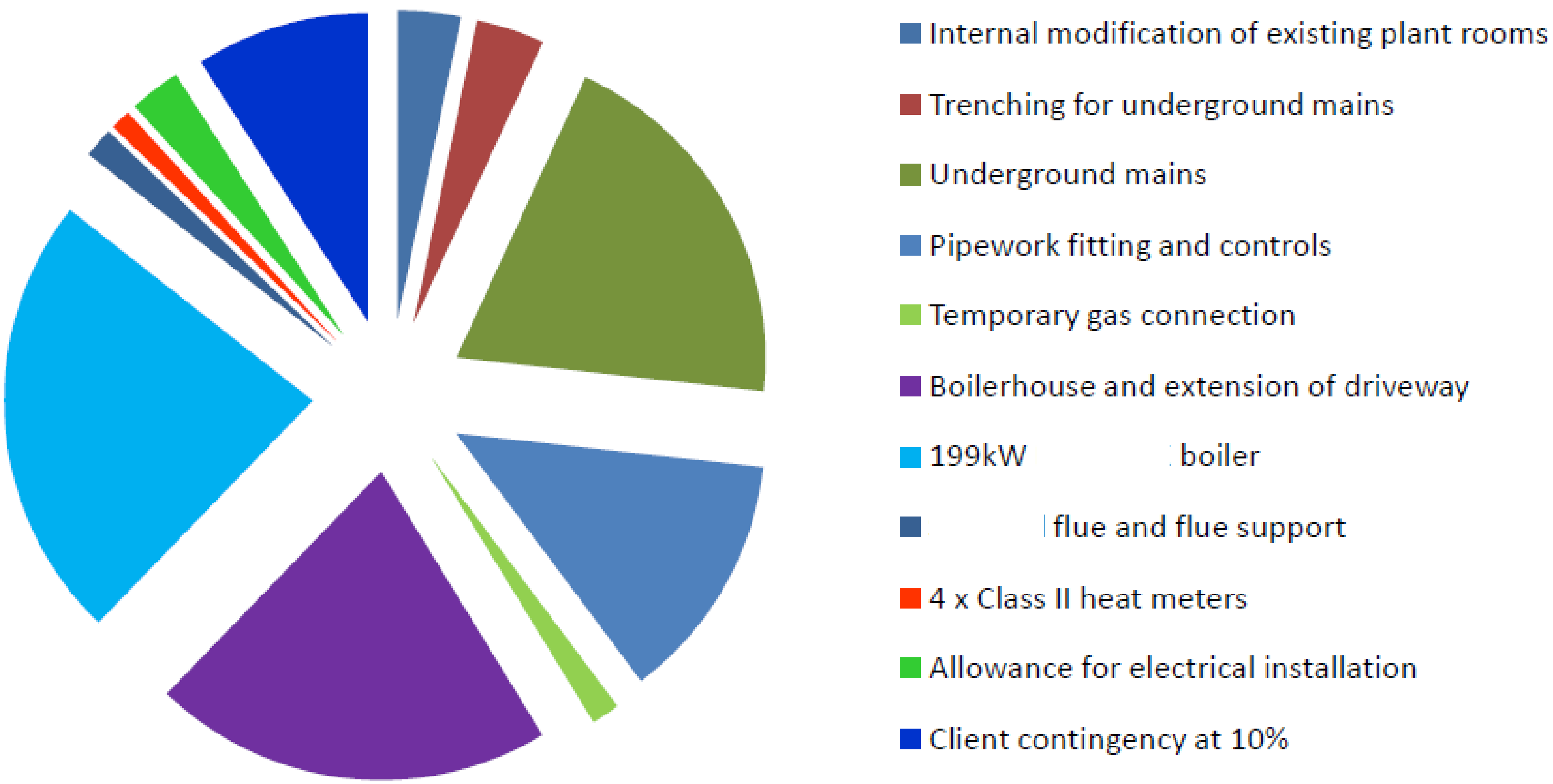
Typical Project Costs

Figure 5-6 *Capital costs (system and design only) of typical biomass systems*



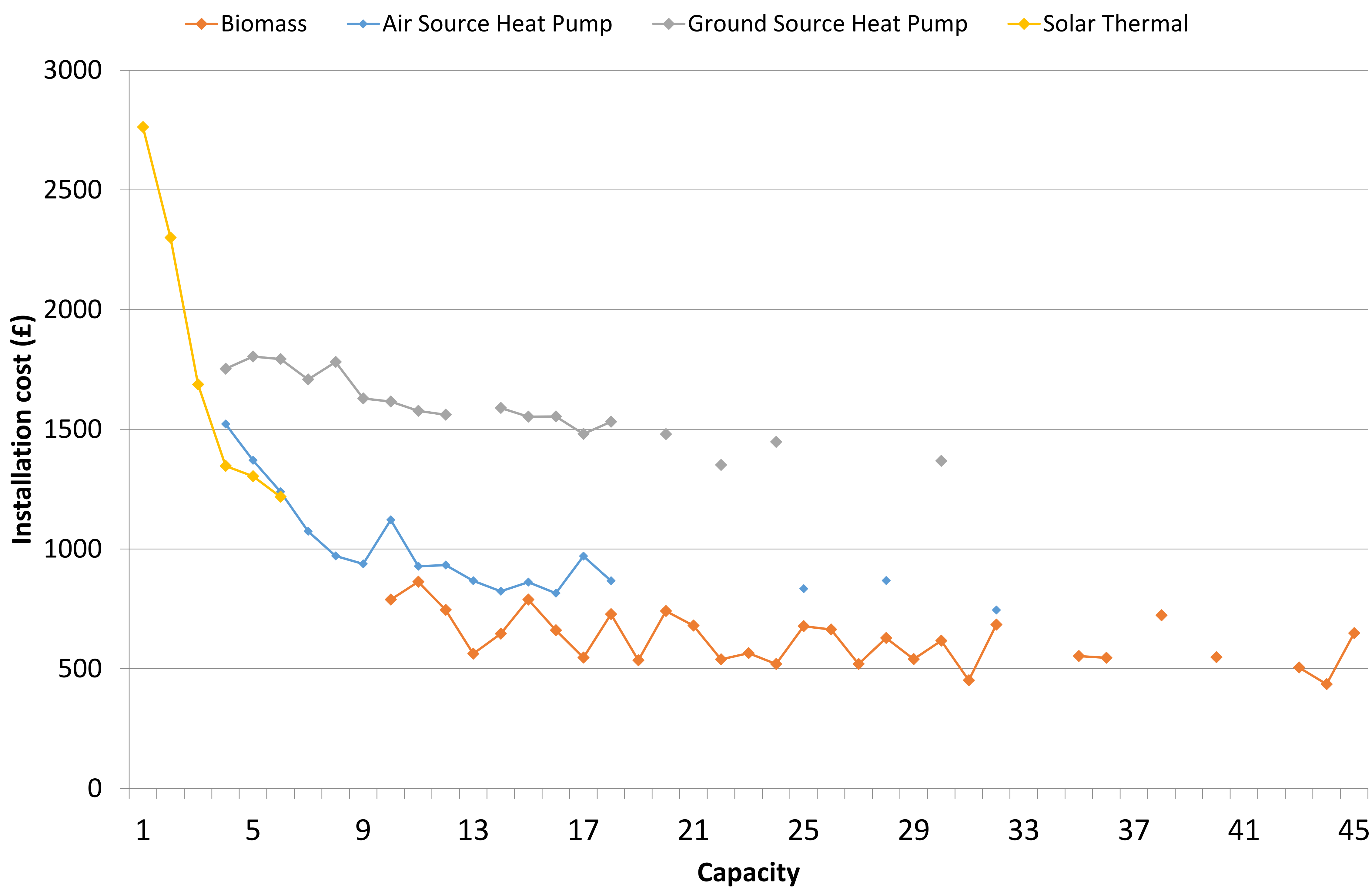
TYPICAL PROJECT COSTS

Typical Cost Breakdown



TYPICAL PROJECT COSTS

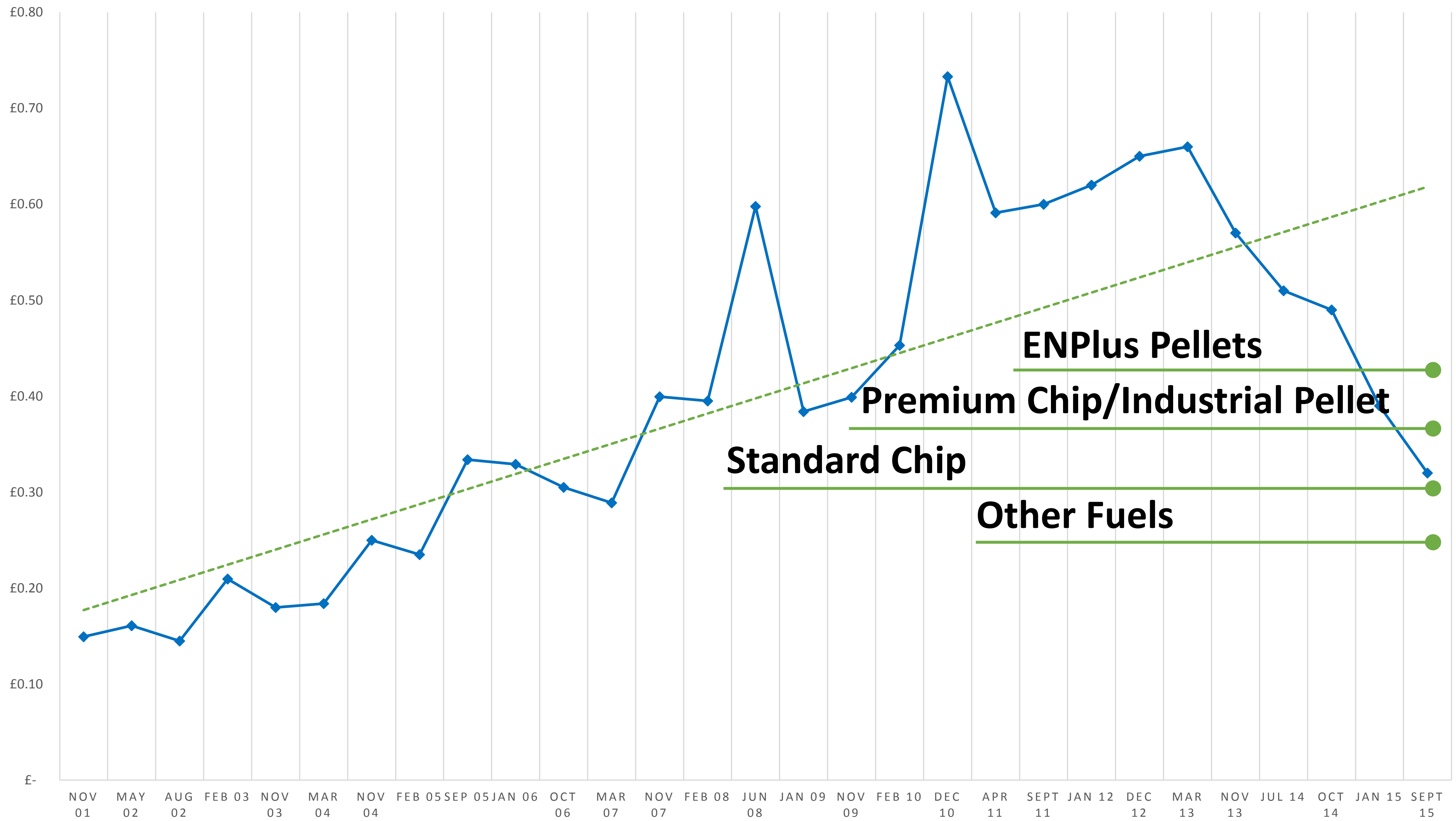
Domestic RHI Reported Installation Costs (Oct 15)



Fuel Costs

FUEL COSTS

Fossil Fuel Costs (Heating Oil) 2001-2016



Renewable Heat Incentive

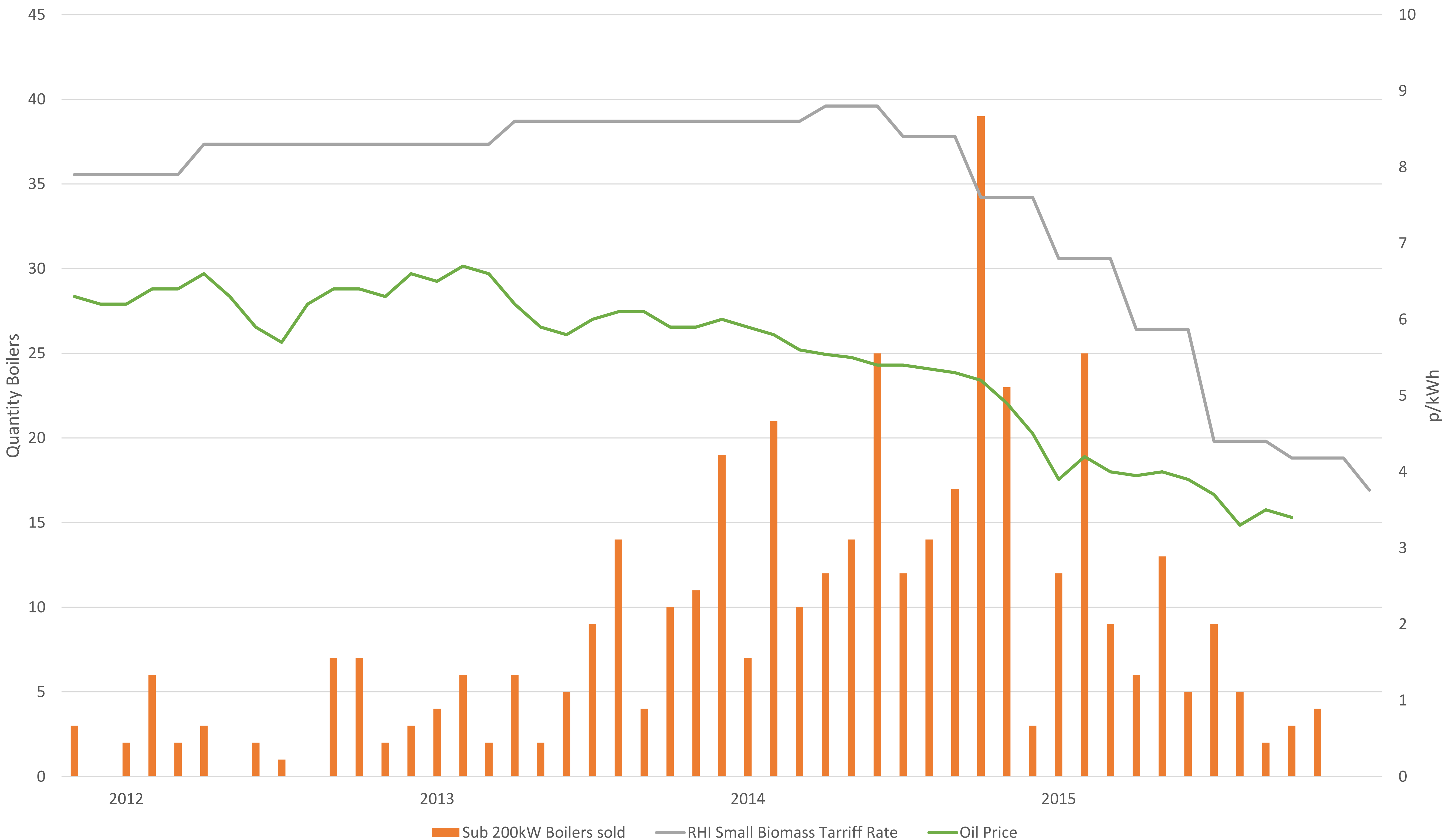
RENEWABLE HEAT INCENTIVE

Rates for Biomass from 1 July 2016

Tariff name	Eligible technology	Eligible sizes	Tariffs
Small commercial biomass	Solid biomass including solid biomass contained in waste	Less than 200 kWth Tier 1	3.26
		Less than 200 kWth Tier 2	0.86
Medium commercial biomass		200 kWth and above & less than 1MWth Tier 1	5.24
		200 kWth and above & less than 1MWth Tier 2	2.27
Large commercial biomass		1MWth and above	2.05
Solid biomass CHP systems (commissioned on or after 4 December 2013)	Solid biomass CHP systems	All capacities	4.22

RHI - MARKET IMPACT TO DATE

Oil Price, Small Boiler Sales and RHI Degression



Indicative annual deployment by 2021		
Technology	Domestic	Non-domestic
Biomass	1,000	60 large biomass 5 biomass CHP
Heat pumps	13,700 ASHP 2,500 GSHP	1,000 ASHP 2,200 GSHP

Building a Business Case

re:heat

Reflecting Priorities

Primary	Secondary
Revenue generation/cost savings	"Right thing to do"
Carbon reduction targets	Local leadership
Replacement of ageing plant	Personal convictions of staff
Addressing air quality issues	Anticipating legislative changes
Local employment creation	

Overriding requirement will always be that there is a strong economic case for switching from fossil fuel to biomass (or any other form or renewable energy).

Typical Project Phases

Pre-Feasibility	Full Feasibility	Detailed Design	Permissions & Consents	Procurement	Construction & Installation	Commissioning	Operation & Maintenance
Establishes initial technical and economic viability and case for investment.	Consultant works through following : • operating profile of heat system; • current energy requirement; • future energy requirement; • fuel prices now and in future; • estimated system size; • outline design concept; • project timeline; • budget cost; • overall case for investment.	Design concept agreed with client. Consulting engineer appointed to work through detailed design of : • system sizing; • fuel reception and handling system; • civils and building design; • combustion system and boiler specifications; • heat distribution system; • controls and integration.	Planning permission sought for any new structures or modification to existing structures.	Procurement of boiler and other components. Procurement of integration and enabling works to heating system. Visits to example sites and possibly manufacturer facilities. Maintenance contract. Contractual terms and conditions agreed.	Site works.	Commissioning of boiler and ancillary equipment. Performance criteria met. Emissions criteria met. RHI registration. Operator training. Handover. Troubleshooting.	Ongoing operation. Planned and preventative maintenance schedule.
	Fuel Supply (if applicable)						
	Estate forest resource assessment: • Indicative wood fuel volume requirements established • Assessment of equipment of use to forestry team	Integration of wood fuel requirements into existing forest management plans Fuel volumes and quality criteria informed by detailed design work.	Equipment requirements established. Grant applications to relevant bodies. Wood fuel WIG application submitted	Procurement of equipment to self-supply. Buildings erected for chip storage and drying Wood fuel harvesting, stacking, storing and drying begun.	Contract chipping (if required) Delivery dry runs. Training (if required). Fuel quality assessment procedures established.	Commissioning loads delivered. Fuel quality testing.	Ongoing quality management. Ongoing availability monitoring & legislative compliance checks.

Rosehill Care Home

40 elderly residents, many with complex needs, in hybrid building - Grade II listed house with 1960's/1970's additions;

Consuming c. 990,000kWh heating oil (95,000 litres) per year, at a cost in 2013 of c. £64,000;

Not-for-profit trust with healthy cash reserves, desire to move to low carbon heating, reduce costs, generate revenue, show leadership *and* imminent need to replace ageing boiler plant;

Tender exercise summer 2014;

re:heat awarded contract March 2015.

Rosehill Care Home

Project required construction of new plant room and fuel store for wood pellets - walled garden provided perfect location;

Pre-insulated heat mains used to connect into existing plant rooms which house oil boilers, pumps, etc…;

Project is a substantial undertaking, with total contract value of £235,000.

Rosehill Care Home

Boiler installed - 500kW pellet system;

Project timeline - procurement c. 9 months, contract award to heat supply, 3 months;

A1 ENPlus Bulk wood pellets at £180/tonne secured for 12 months (c. 3.8p/kWh, gross);

Replacing oil at current price of 3.5p/kWh - recent plunges in oil price have eroded cost saving available from fuel switching (chip would be c. 3.2p/kWh);

Anticipated RHI income associated with project = £41,492 per annum (year 1 figure).

Project benefits :

5.5 year payback (assuming oil and pellets remain roughly equivalent - unlikely!);

243 tonnes of carbon emissions avoided annually;

Once payback achieved, RHI income accrues to the Trust for the remainder of the RHI period - 14.5 years;

RHI surplus of >£600,000 over the duration of the scheme (not accounting for RPI link);

Complete replacement of end-of-life heating plant.

Four separate heat uses/systems around a 1960's industrial unit;

Total heat energy bill in the region of £37,500 for space and process heating;

Heat used in very different ways : standard oil boiler and rads in office; ceiling-mounted direct oil burners in factory; hand-filled oil burner in paint shop and mutiple 3kW 'kettles' for tool warming;

No central heat production, no real controls other than office boiler.

FACTORY SPACE HEATING	450,000kWh/annum	£15,750 on oil
OFFICE SPACE HEATING	25,000kWh/annum	£875 on oil
PAINT OVEN	66,000kWh/annum	£2,310 on oil
TOOL HEATING	70,000kWh/annum	£6,700 on electricity

Taken together, some 541,000kWh of heat are used across the site;

Project will centralise heat production from a pair of woodchip boilers at c. 400kW, with heat piped to each point of use;

Capex likely to be in the region of £200,000;

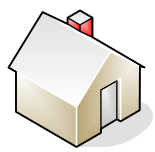
Fuel costs will drop from £25,635 to £16,771 on chip at 3.1p/kWh;

Majority of RHI payment will be in upper band at 5.1p/kWh (525,600kWh), with some in lower at 2.1p/kWh (15,400kWh);

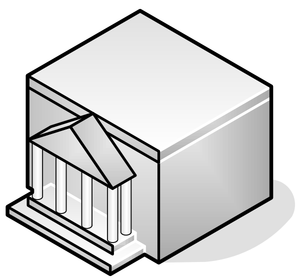
Total RHI income IRO £26,800, delivering simple payback of 4.1 yrs.

BUILDING THE BUSINESS CASE

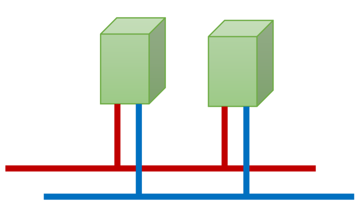
Consider District Heating



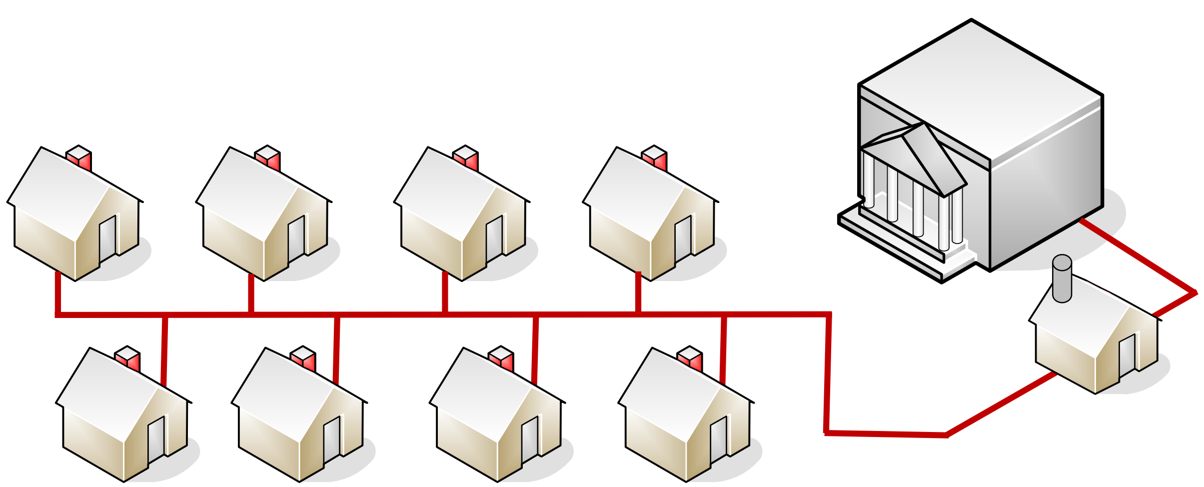
Pellet boiler (c. 15kW) installation in single domestic property - £15-20,000.



Pellet boiler (150kW) installation in municipal property - £80-120,000.



In-building works for district heating connection - £3-5,000.



District heating main - c. £100/linear metre.

8 houses + municipal building - c. £170,000.

Capex saving at least IEO £50,000.

Incremental cost of boiler plant is lower per kW installed as economies of scale are introduced;

As scale increases, fuel substitution is possible, < costs further :

Bag Pellets	Bulk Pellets	P45 Chip	P63 Chip	P100 Chip
4.6p/kWh	3.8p/kWh	3.2p/kWh	2.7p/kWh	2.4p/kWh

Where heat is sold to tenants, margins can increase dramatically, esp. where tanker-delivered fuels are displaced;

And of course, more kWh through the boiler equates to higher RHI receipts.

Backup boiler (where required) can be a single unit, rather than multiple units);

Virtually all maintenance is associated with the central plant - reducing running costs substantially;

Lifetime replacement costs are lower, and generally relate only to in-building components and boiler - heating mains are long-life;

Where social objectives are a consideration, opportunities exist to reduce the cost of heat provided to tenants;

Risks are removed - no combustion in properties (CO, etc…).

All emissions are centralised in a single plant - reducing air quality issues and making clean-up technology cost-effective to implement;

With current supply chain, woodchip only really justifiable for use in boilers rated at 100kW and above - DH allows this threshold to be reached at many more sites;

DECC's Heat Network Delivery Unit (HNDU) has significant resources available to support district heating feasibility and investment (£300m).

WAFFLE

Efficiencies

Defined as : ***the ratio of the useful work performed by a machine or in a process to the total energy expended or heat taken in.***

Why do we care?

Implications for project and business economics;

Implications for reputation of the technology and sector;

Implications for the fuel supply chain (a double edged sword);

Implications for the reform/continuation of the RHI.

Why Are We So Interested Now?

New growth in the biomass market has stopped when compared to 2012-2015 rates.

Fuel supply chains in many areas is insufficiently mature and without enough scale to continue - consolidation and need to drive up efficiency.

Previous exponential growth of RHI-driven market has meant complacency, ignorance and ‘flabbiness’ in our approach to efficiency.

Legacy of rapid market growth under the RHI needs to be addressed…

EFFICIENCIES

Where Are They Important?

Efficiencies are important throughout the supply chain;

Inefficiency is reflected in one of two ways - in the cost of delivered energy paid by end user **or** profitability of the suppliers' business;

Implications are serious regardless of where inefficiencies occur in supply chain - business failure for fuel suppliers *"I'm busy so I must be making money"* **or** high running costs and dissatisfaction on the part of the end user;

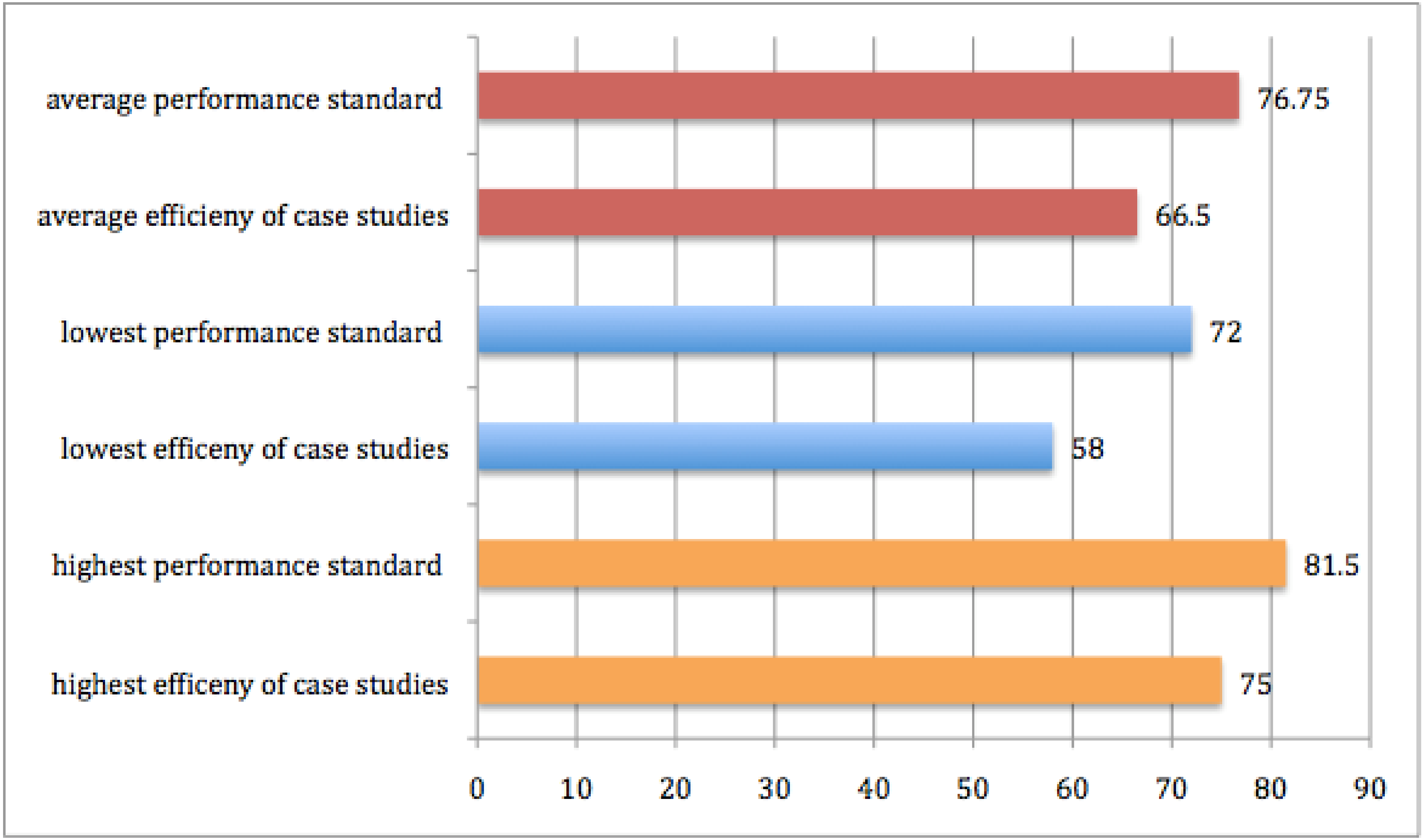
Both have implications for the reputation of the industry, its growth and its reputation with customers and Government.

Central conclusion was that the typical levels of actual system efficiency (excluding district heating networks) appeared to be in the range of 58% to 75%, with an average figure of 66.5%.

Sites	Average	Median	Top Ten Avg	Best
63 x Large Retail Sector	55%	58%	71%	85%
1 x pellet fired residential scheme	90%			
5 x high rise (forecast not actual)	69%	72.3%		77%
Large Hospital	59%			
Village hall pellet boiler	74%			
8 x schools	72%			

EFFICIENCIES

DECC Research 2014



In the boiler (1) - *combustion efficiency* (energy in minus flue losses);

In the boiler (2) - *boiler efficiency* (includes radiation and unburnt fuel losses);

In a heating season - *annual plant efficiency* (useful heat in - all losses in a year);

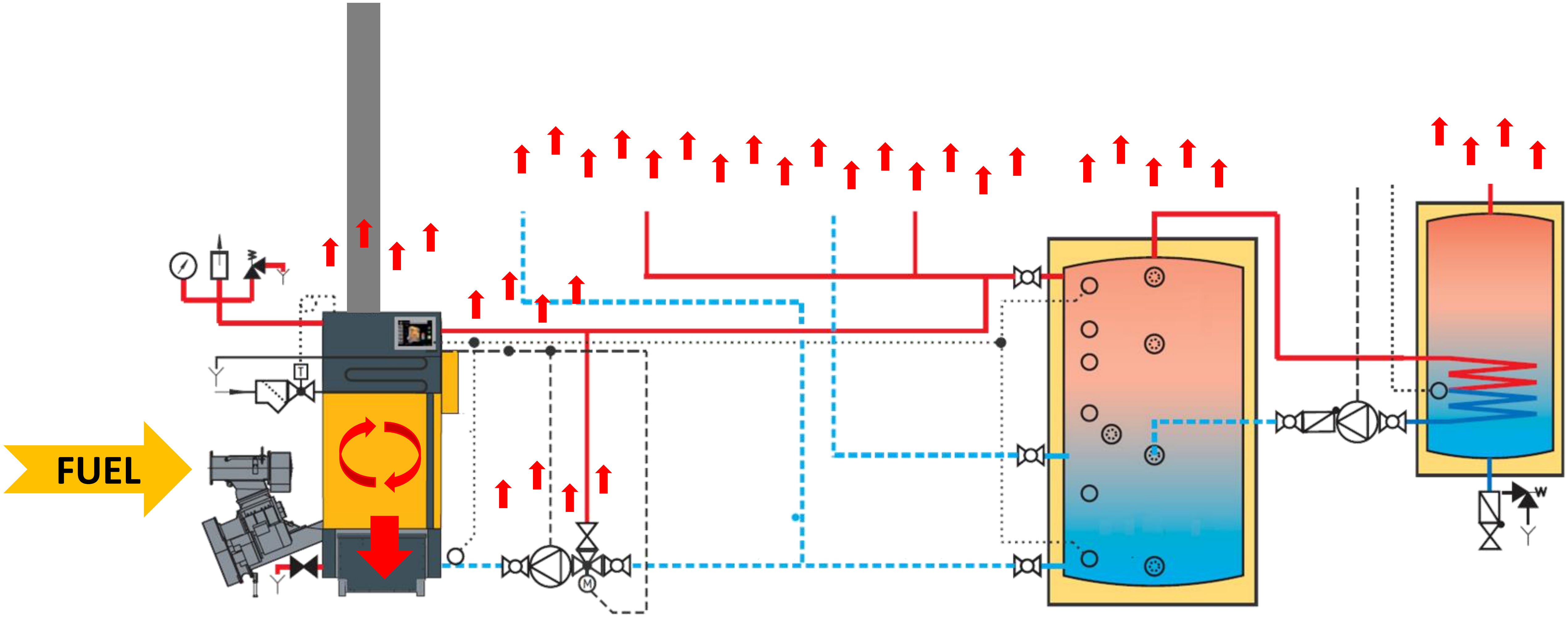
As an investment - *operational efficiency*.

Combustion efficiency

Boiler efficiency

System efficiency

= kWh = £



Combustion and Boiler Efficiencies

Combustion efficiency is an *instantaneous value* measuring heat output (combustion) and heat input (in the form of fuel);

Because it's an instantaneous value, it should not be used as a true measure of efficiency, which should include measurement across a period of time;

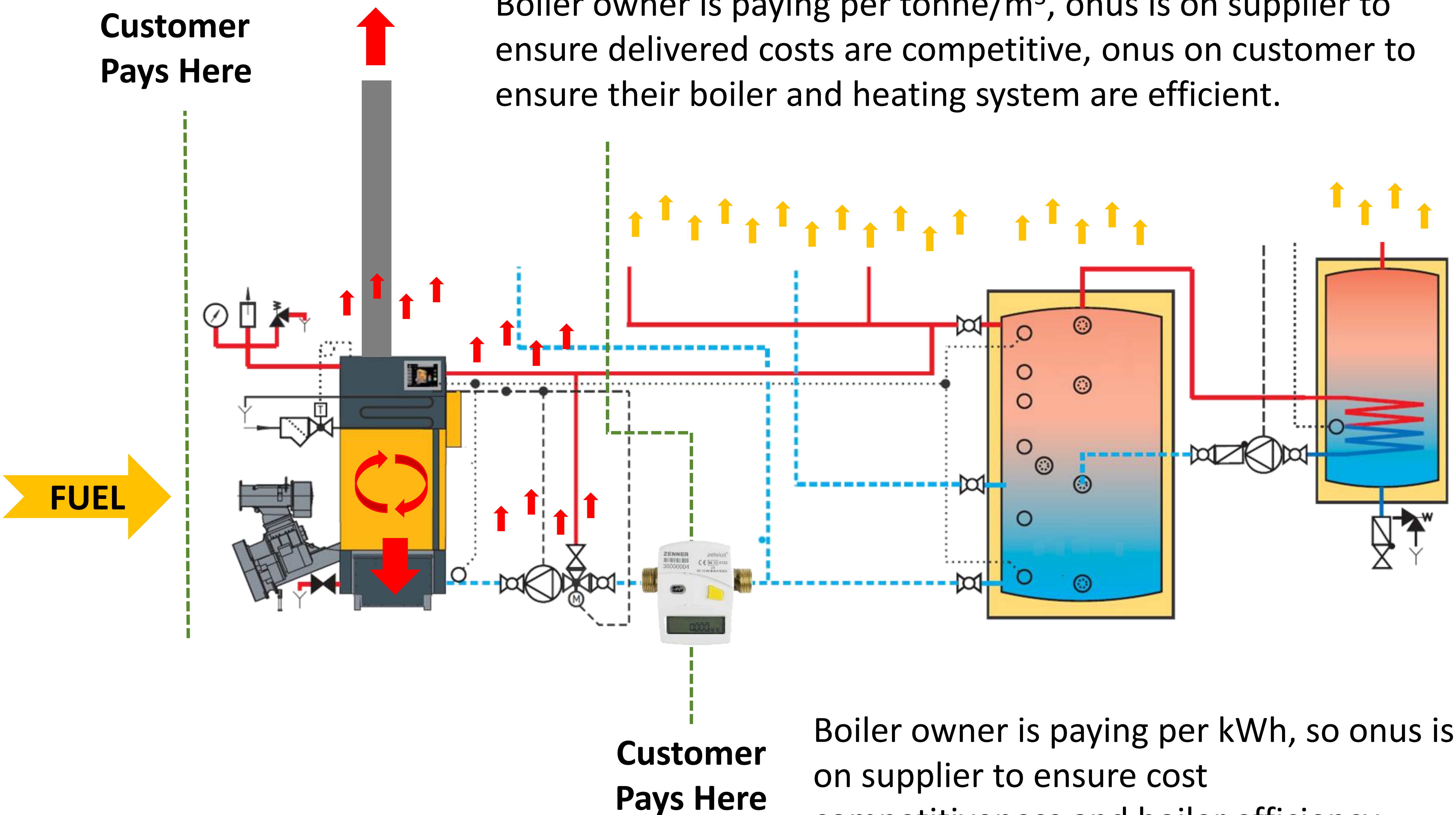
Boiler efficiency is a time-averaged measurement, typically taken over a few hours, and is a more 'honest' reflection of efficiency.

INEFFICIENCIES

Who Pays?

re:heat

Boiler owner is paying per tonne/m^3, onus is on supplier to ensure delivered costs are competitive, onus on customer to ensure their boiler and heating system are efficient.



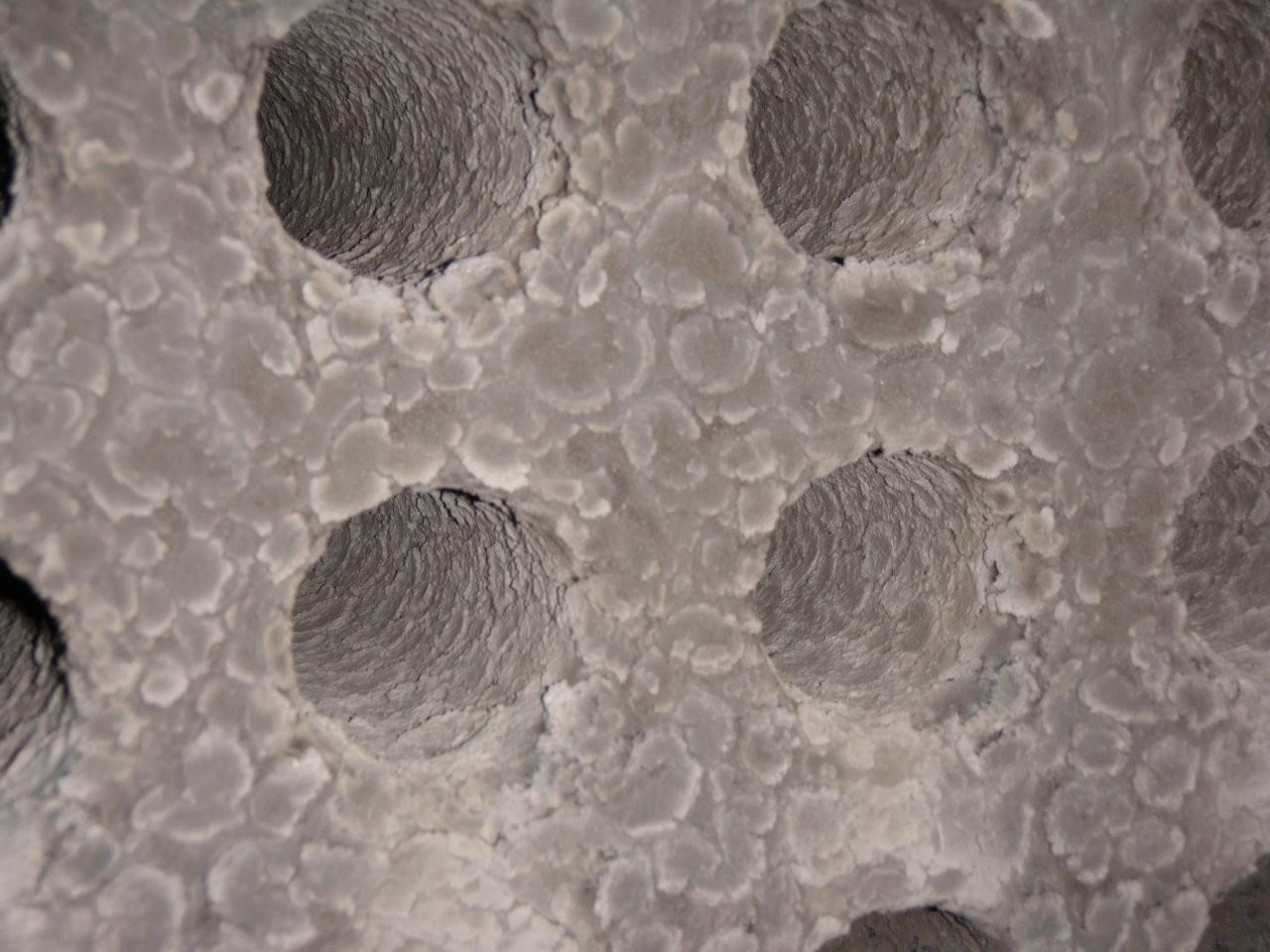
Boiler owner is paying per kWh, so onus is on supplier to ensure cost competitiveness and boiler efficiency.

Operational Efficiencies

Operational efficiency is a bit of a "catch all", but should include things like :

- Electrical inputs;
- Labour inputs, e.g. overseeing fuel deliveries, system checks, routine maintenance and cleaning, de-ashing, etc…;
- Other materials, e.g. grease, hydraulic oil, etc…
- System availability - if a system isn't running, then a more expensive alternative is being used, or people are cold, and RHI income isn't being earned.


MANUSCRIPT Handwriting Pen
18/03/2012



Efficiency of fuel reception can make or break project economics.

- Has implications for delivered cost of fuel - a long wait for unloading can add £50 or more per delivery;
- Particularly with pellets, poor deliveries can degrade fuel, causing problems for boilers operation or loss of fuel from system;
- Need to intervene manually carries a cost for someone, but customer ends up paying in the end;
- Can also have serious health and safety implications…

Fuel store design has various implications for efficiency :

- Failure to make a store weathertight will lead to re-wetting of fuel, reducing available energy - direct efficiency impact;
- A store which is not optimally sized increases the per-tonne cost of the fuel - operational efficiencies;
- A store which requires regular manual intervention incurs a labour cost for supplier and/or client (and poses a safety risk).


<1m

Biomass boilers are mis-sized as a matter of routine.

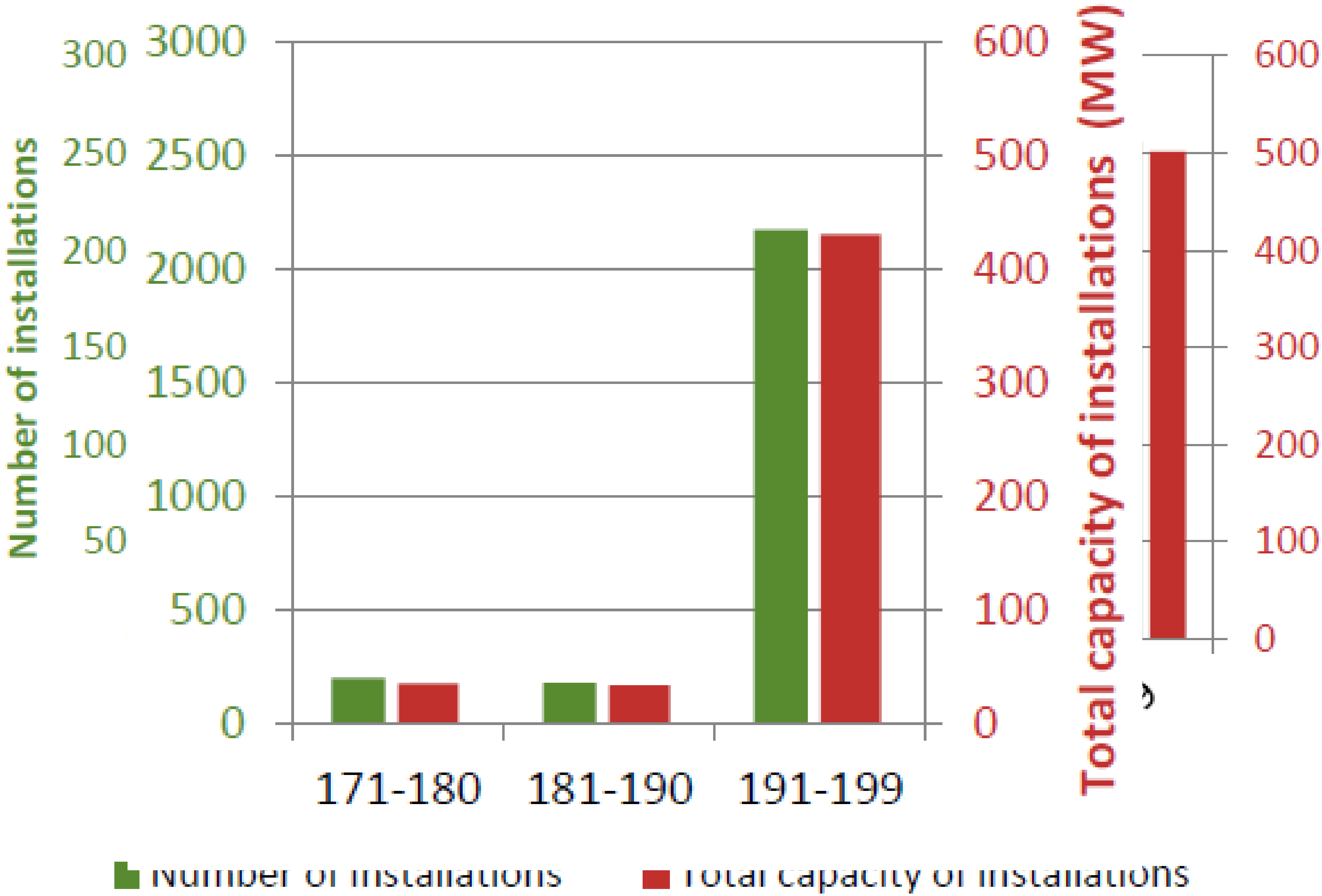
In part due to standard (bad) practices in heating industry - *“if it’s bigger, they won’t get cold”.*

Design of RHI, with sweet spots at 199kW (until recently) and 999kW, meant companies actively target particular boiler sizes to present enhanced economics.

Implications for efficiency are significant - short cycling, poor combustion efficiency, increased use of ignition system, etc…

EFFICIENCIES

Boiler Size



Quit remote control

Brian Boiler | Buffer | Store | Sys

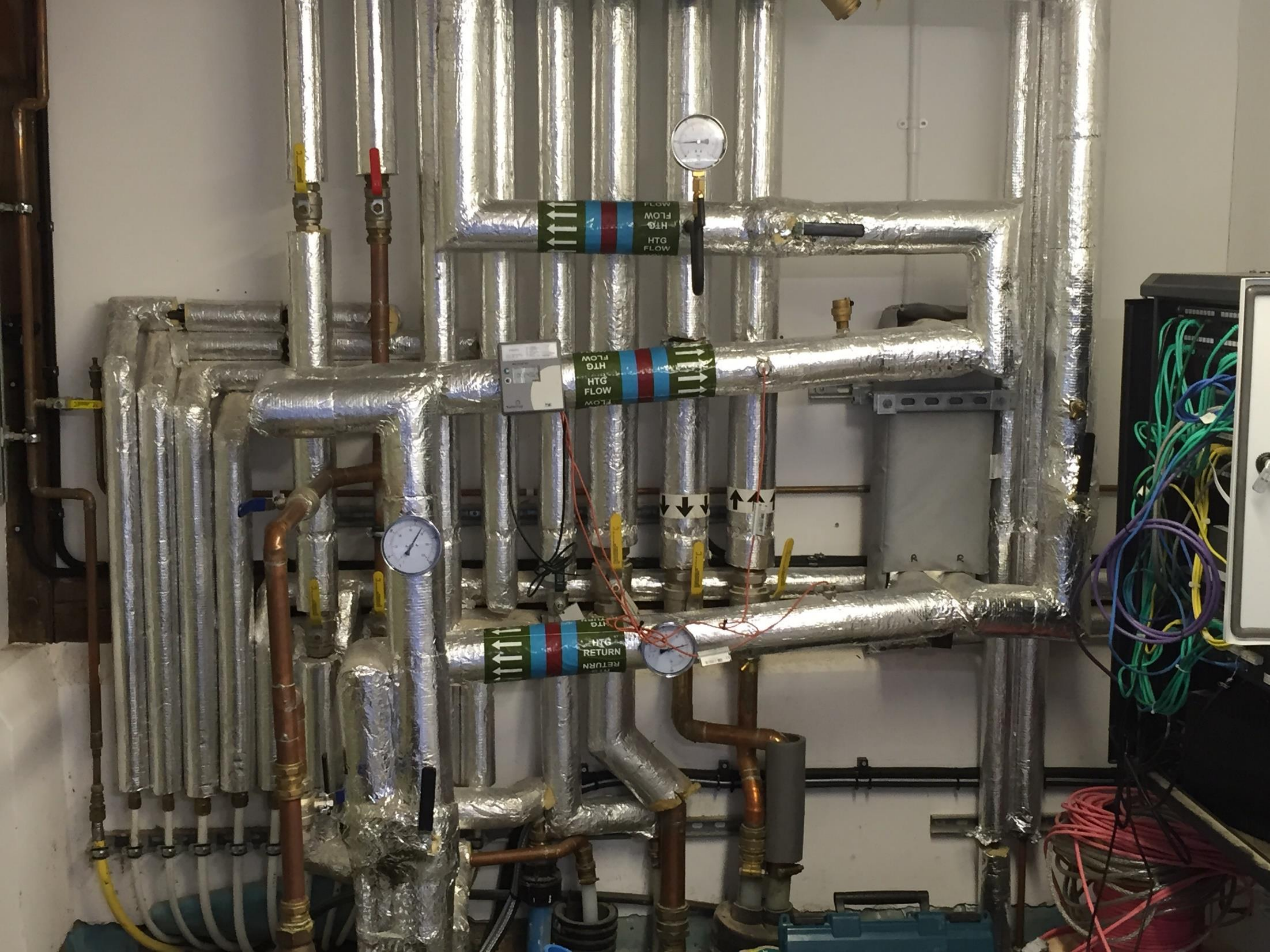
Text	Value
▹ Outputs	
▾ Counters	
Full load hours	1724h 40m
▹ Consump. since maint.	10480 kg
Total consumed	10483 kg
Pellet bin contents	52 kg
Consumption since de-ash	21 kg
Consump. since ash box empt	347 kg
Heating counter	3007
Ignition counter	2756
Safety temperature limiter ac	0
Reset	101

Service   Sun 8. 5, 10:56:25

Hydronic design of a system is hugely important in ensuring efficiency and good operational performance;

You can get everything else right and undo it all in an instant with poor downstream design. Think about :

- Pipe and pump sizing;
- Zoning;
- Flow and return temperatures;
- Quality of components and finishes, e.g. insulation levels.


HTG FLOW
HTG FLOW
HTG RETURN


SUPAFLEX


CHECK

Controls are often looked on as an optional extra on biomass systems :

Customer : *"You're just trying to sell me more stuff"*

Installer X : *"You don't need all that stuff the other guy has included"*

Controls are a very wise investment, as **all** they are designed to do is increase efficiency and improve the overall customer experience!


Ho
Status
Settings
Assist
Liquid temperature
31 °C
MAGNA3
OK

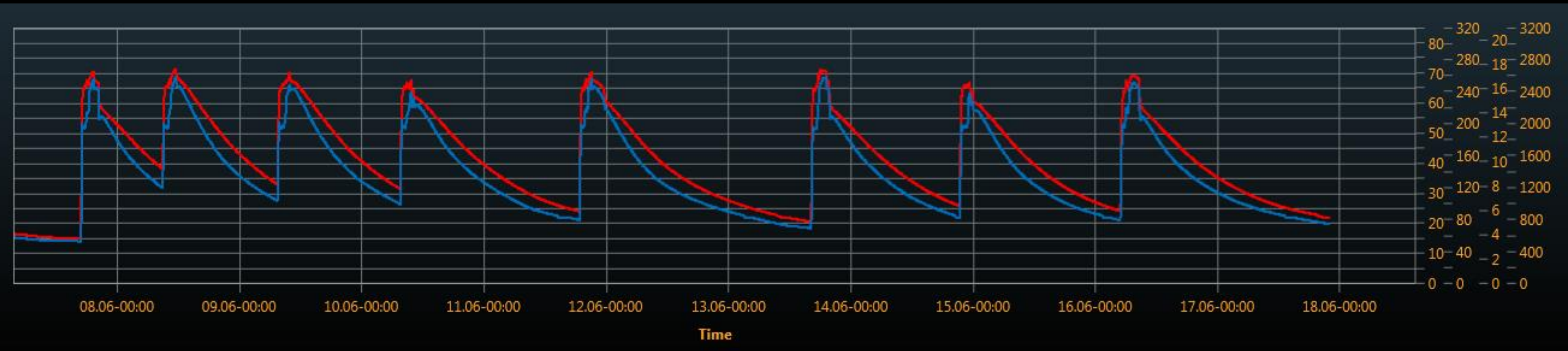

Status
Settings
Assist
Speed
4630 rpm
MAGNA3
OK
GRUNDFOS

Ho
Status
Settings
Assist
Operating hours
11688 hours
MAGNA3
OK


Status
Settings
Assist
Energy consumption
1388 kWh
MAGNA3
OK
GRUNDFOS

£336 in 16 months (assuming 12p/kWh)

>£5,000 over a 20 year period.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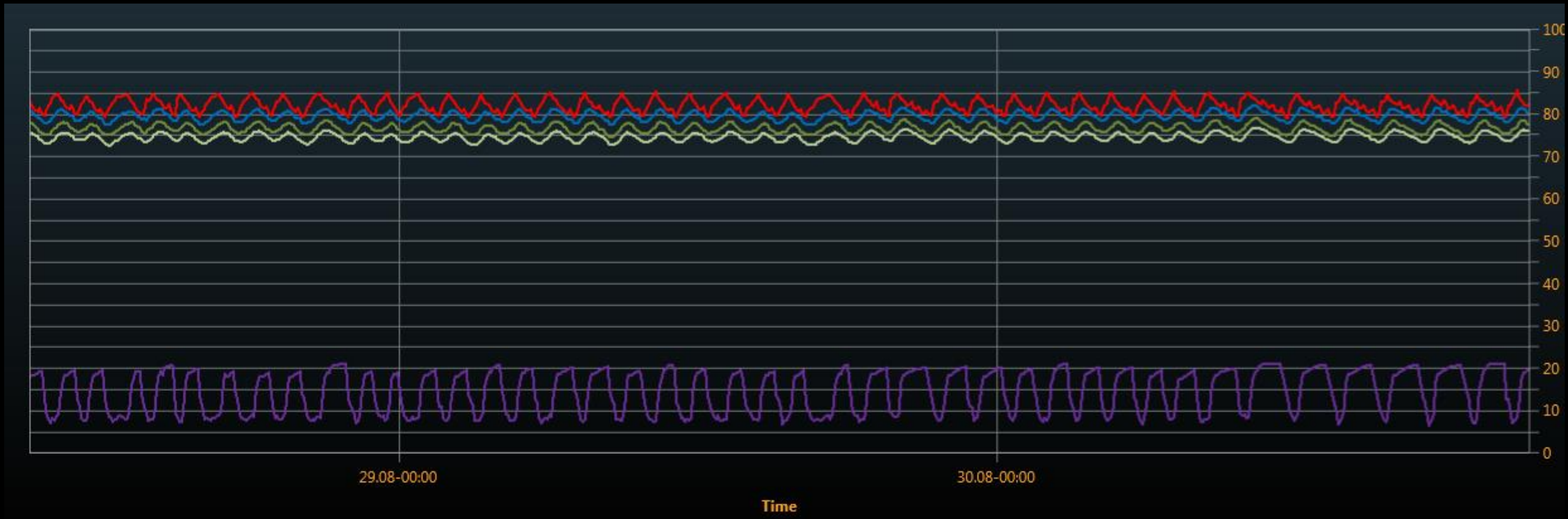
Time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30.08-00:00
Time

Like any manufactured product, biomass boilers come in different shapes and sizes, and from different manufacturers who have taken different approaches to solving problems (or have ignored them);

Typically, the higher the degree of automation on a biomass boiler, the lower the degree of operator intervention (maintenance), but the higher the amount of specialist servicing - there's more to check.

Boilers range from a 'fire in a box' requiring daily manual intervention, to one that will email you when the ash bin is full. Every application is different, and it's about choosing equipment that offers the right balance of automation and robustness.


Caution
Hot
binder
Caution
Hot


Type
Model
CE

EFFICIENCIES

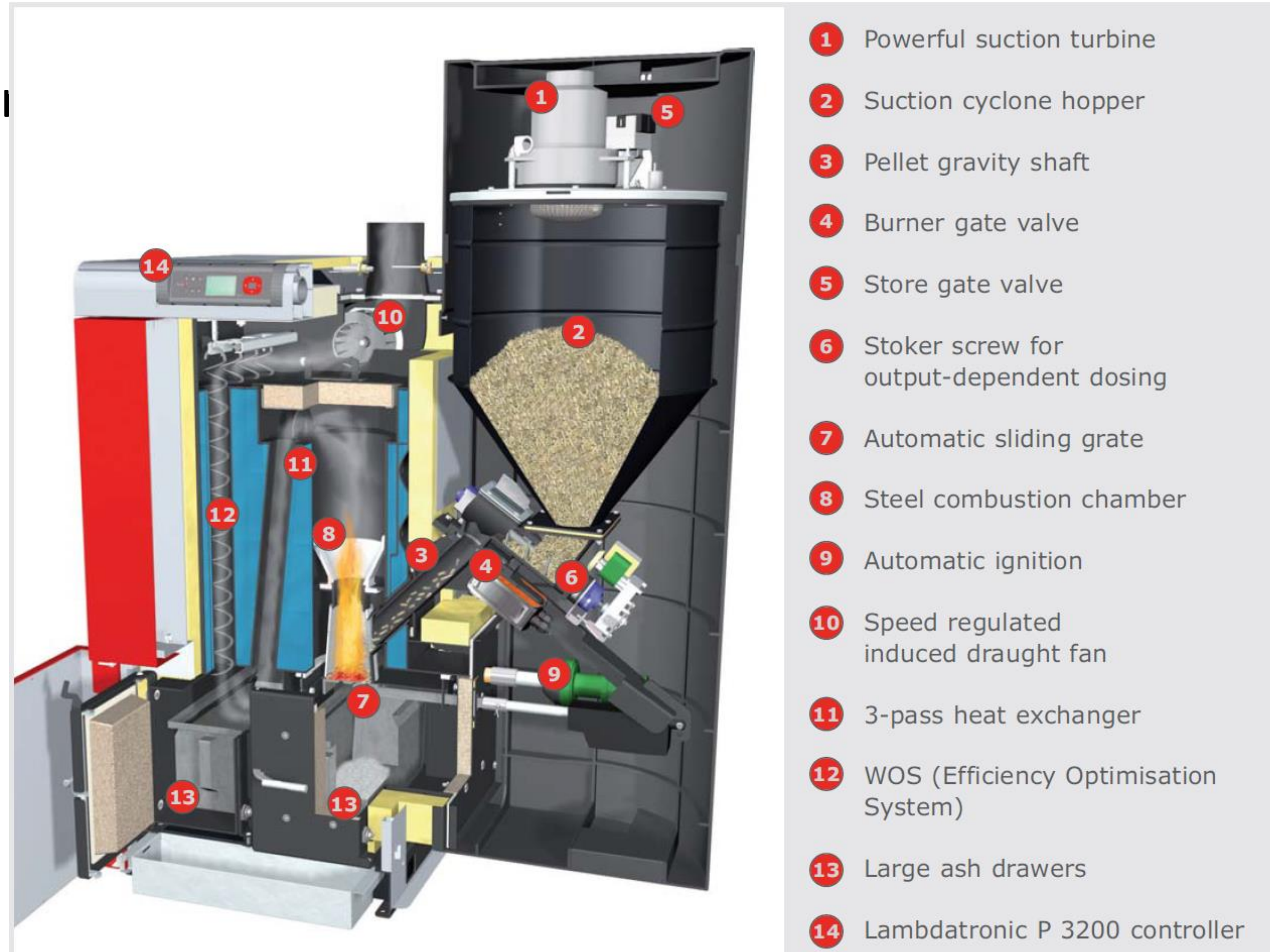
Servicing

re:heat

Biomass boilers burn a solid fuel, and unless they're replacing a coal boiler, the servicing requirement will be higher than that of the equipment it is replacing;

Proper servicing is a requiremen of the RHI regulations;

And is vital to ensure the longevity and efficiency of the boiler!



Servicing costs associated with biomass boilers are invariably higher than those of fossil fuel boilers because of the complexity of the equipment and the nature of the fuel;

Operating duty and fuel quality will also have implications for service costs.

Standard - [redacted] biomass boiler

Two service visits per annum. Included is a full service and a combustion check and condition report

Annual charge: £1,350.00

High Usage - [redacted] biomass boiler

Three service visits per annum. Included is two full services and a combustion check and condition report

Annual charge: £1,835.00

Ancillary items such as heat meters, loading systems, etc… may also incur servicing costs.

Operator Issues…

Biomass boilers and their associated components are complex;

Incorrect operation can result in damage or loss of equipment, property, life or limb!

Ensure operators are properly trained and ***actually competent***;

If you’re an owner, designer or installer, you are legally liable for anything that might happen to an individual working with or on the equipment you are responsible for.

Implications for the Business Case

An inefficient biomass boiler installation has implications for :

- Fuel costs - more woodfuel and/or more fossil fuel;
- Other running costs, e.g. electricity, labour, consumables;
- RHI income;
- Ability to service debt finance;
- Emissions;
- Tenant satisfaction;
- Business continuity;
- Industry reputation;
- Maintenance burden.

Use key guidance documents to educate yourself :

- These tell you what questions to ask and help you assess the answers.

Select an consultant or specialist firm with a track record and references :

- Get multiple references from installations which are similar to what you are planning;
- Considering engaging an independent expert to help with procurement and final sign-off.

Use a performance specification to seek quotations :

- Enables innovation to deliver cost effectiveness as there are many options;
- Include : % biomass, system efficiency, % downtime, full service costing.

Ensure that an experienced person will oversee your installation :

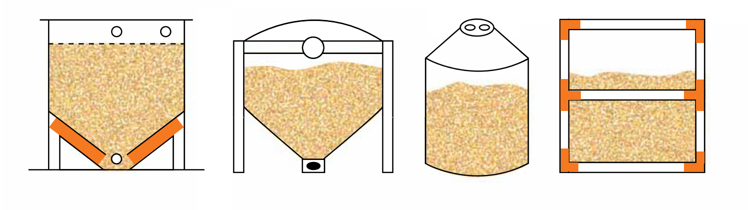
- Even experienced firms have resource constraints at times of high demand.

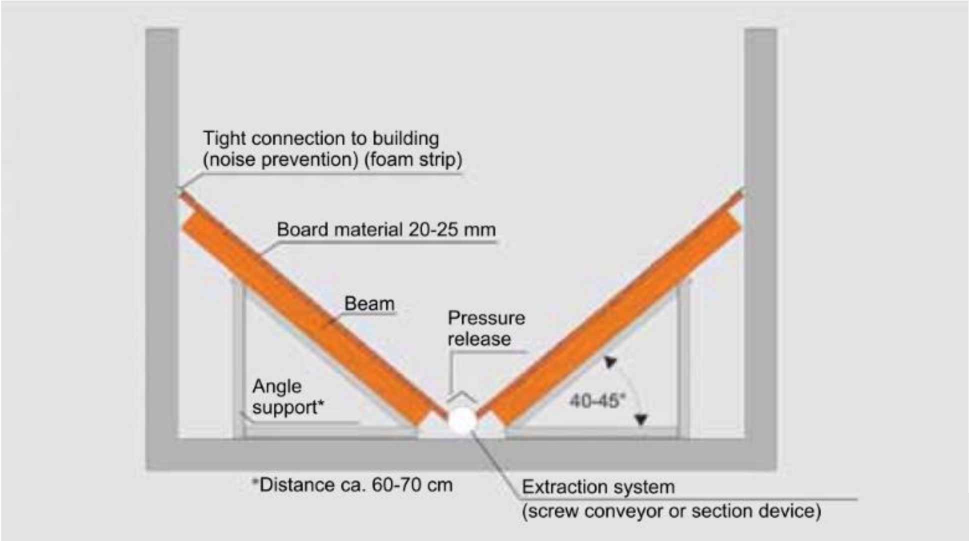
IN SUMMARY

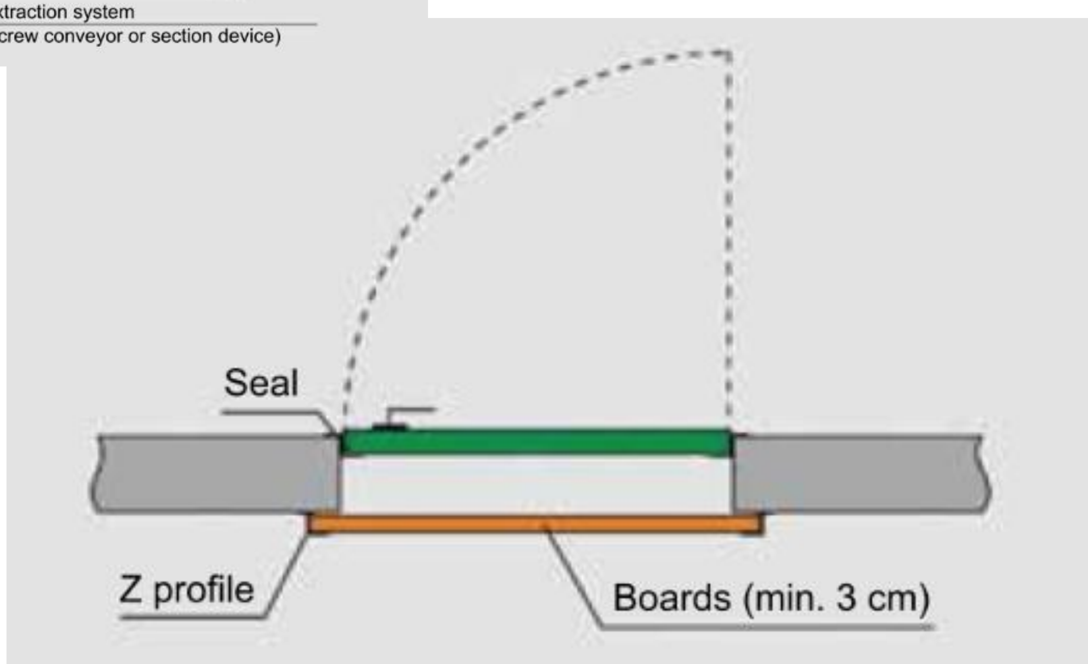
CIBSE AM15 Guide

UK Pellet Council Fuel Storage Guide

Recommendations for
storage of wood pellets



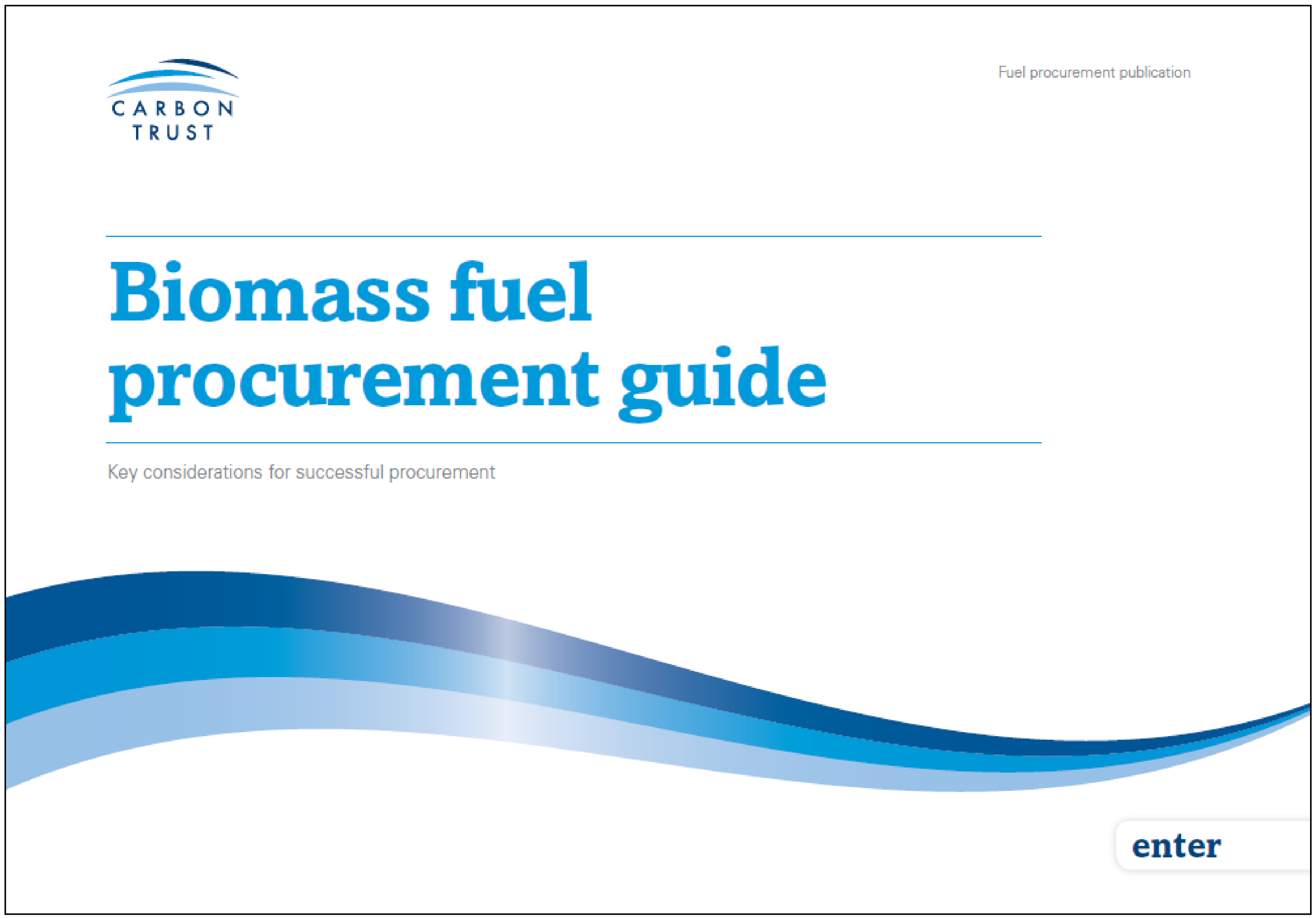




UK Pellet Council

IN SUMMARY

Carbon Trust Fuel Procurement Guide


CARBON TRUST

Fuel procurement publication

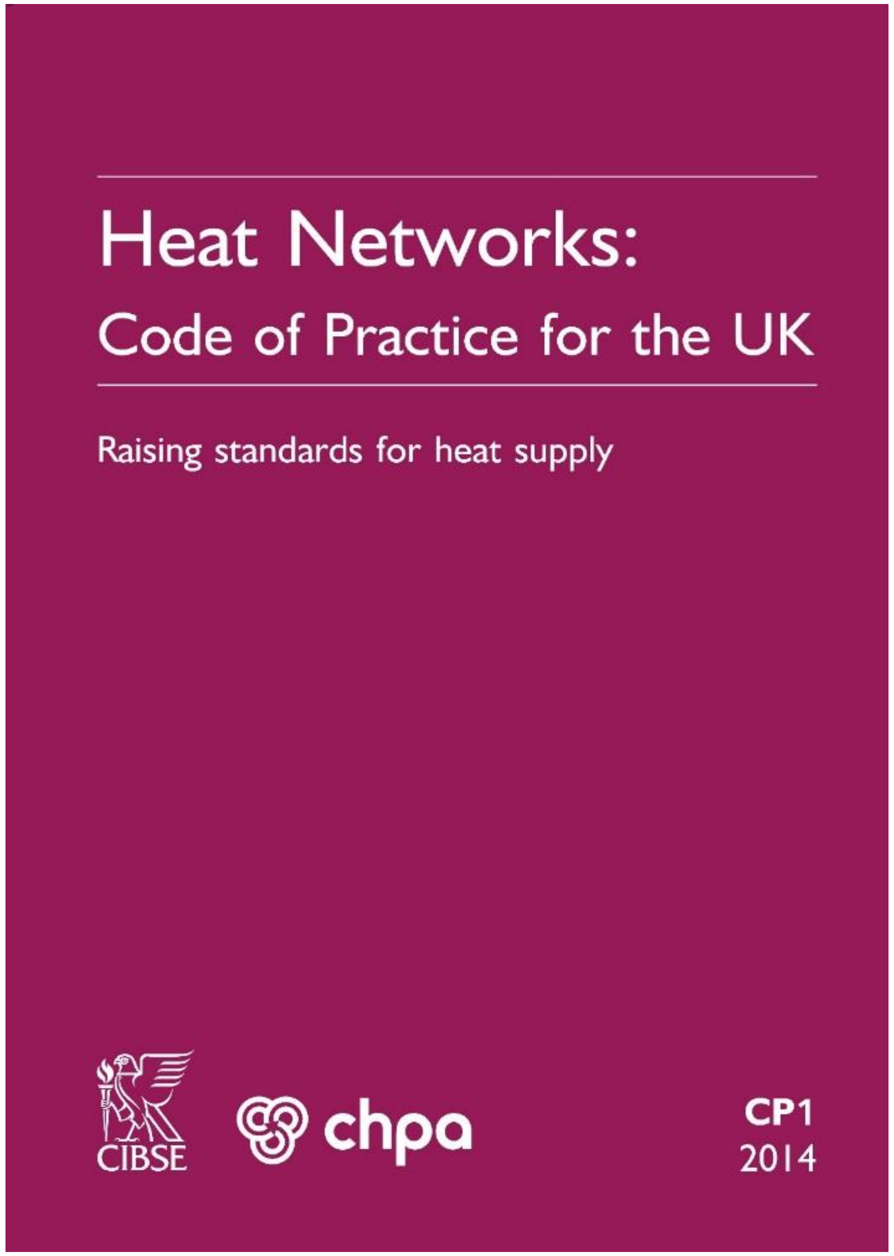
Biomass fuel procurement guide

Key considerations for successful procurement

enter

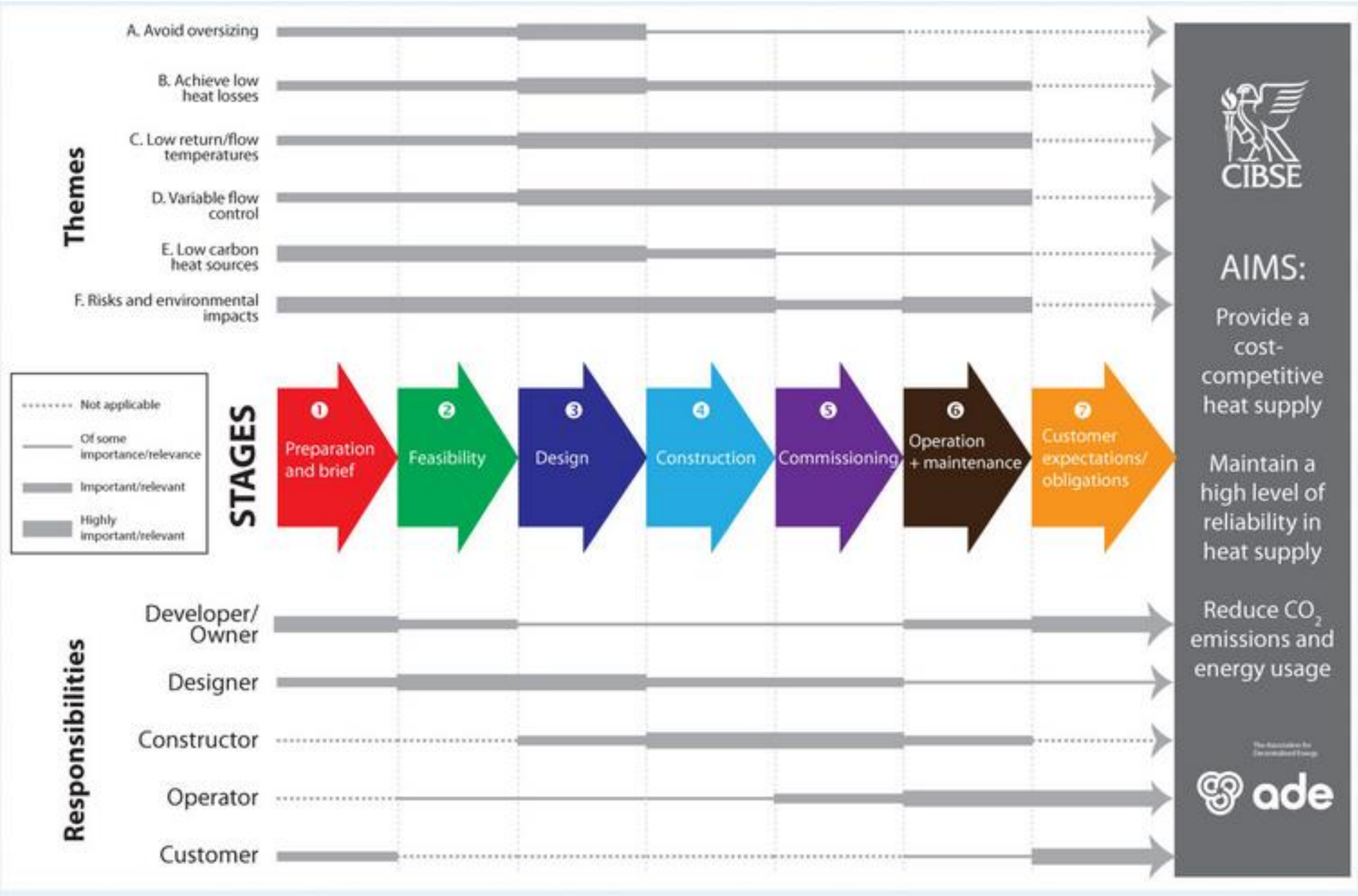
IN SUMMARY

CIBSE Heat Networks Code of Practice



IN SUMMARY

CIBSE Heat Networks Code of Practice



IN SUMMARY

1. The RHI offers a once in a generation opportunity to get off fossil fuels and onto a source of sustainable energy;
2. Efficiency is poorly understood by many installers (and salesmen) and is so poorly communicated;
3. Projects need to progress carefully to avoid pitfalls;
4. The efficiency of a biomass boiler is no better or worse than a fossil fuel boiler - efficiency (or otherwise) is primarily a function of design, specification and installation quality;
5. Poor efficiency has a number of potentially very serious implications;
6. Proper maintenance is crucial for maintaining efficiency, ensuring operation of the equipment and complying with RHI.

WOOD HEAT ASSOCIATION

2016 Conference

Edinburgh Zoo, 28th and 29th November 2016

Programme in preparation

Previous speakers have included :

Edmund Ward, Ofgem E-Serve
Adam Sherman, Biomass Energy Resource Centre, Vermont
Martin Behr, German Pellets Institute
Sara Kassam, CIBSE
Phil Benn, Manchester Tree Station
Jonathan Foxbatt, DECC
Manuel Schwabl, Bioenergy 2020+

"Well done on the conference - it was done in such a way so that lots of new information was provided."
Kevin Lindegaard, Crops for Energy, Bristol

"Thank you for all your efforts with the conference - we thought it was a great success."
David Hugh Smith, Dunster Biomass Heating, Somerset

"All the movers and shakers of the industry openly sharing their knowledge and their time meant I got an honest picture of the sector as a whole."
Richard Weeks, Hall Construction, Hull

"Well organised, insightful conference. Really pleased I attended."
Athol Duckett, Wood Boiler Supplies, Aberdeenshire