Hot water efficiency in homes

A roundtable to discuss the role of policy makers and industry in improving the efficiency of hot water provision

SUSTAINABLE ENERGY ASSOCIATION

Introduction

On 26th November 2019, the Sustainable Energy Association hosted a roundtable to discuss the hot water efficiency in domestic homes. The aim of the roundtable was to discuss the role policy makers and industry can play to support the deployment of technologies that improve the efficiency of hot water provision, reducing waste to the benefit of consumers and environment.

This paper provides a summary of the key points raised during the discussions and the generated recommendations. We hope it will help inform the discussion and feed into the work of the Government and Committee on Climate Change as policy is developed in hot water provision.

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Attendees

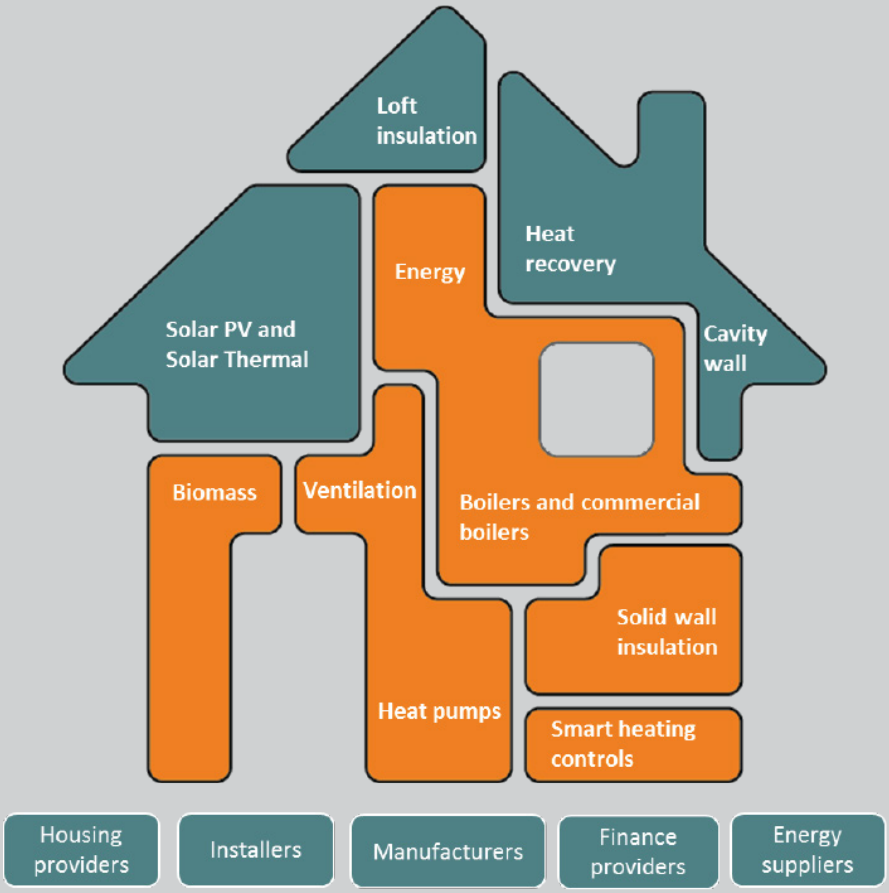
Name	Company
Sarah Castelvecchi	Anglian Water
Jeff House	Baxi
David Style	Committee on Climate Change
Iain Bevan	Daikin UK
Carrie Heitmeyer	Department for Business, Energy and Industrial Strategy
Noeleen Keane	EDF Energy
Brian Horne	Energy Savings Trust
Shaun Hurworth	Glen Dimplex
Florence Gourmel	Mansfield District Council
Max Halliwell	Mitsubishi Electric EUK
Scott Blance	Sustainable Energy Association
Jess Ralston	Sustainable Energy Association
Lesley Rudd	Sustainable Energy Association
Tony Gordon	Showersave
Robert Hicks	Sovereign Housing
Mark Wilkins	Vaillant

About the
Sustainable Energy Association

In a world of finite resources, the Sustainable Energy Association exists to help create living and working spaces fit for future generations. Our work seeks to align the interests of business, politicians and consumers to make this a reality.

We are industry leaders in energy in buildings. We are technology agnostic and provide objective, evidence-based policy positions which help shape how we think about, generate and use energy. We are constructive, collaborative and committed to achieving our vision, by ensuring that buildings are energy efficient, low carbon and warm.

The Sustainable Energy Association (SEA) is a member-based industry body. We draw on our wide-ranging membership from manufacturers of energy saving technologies and heating systems to housing associations with an interest in sustainable energy. SEA member's manufacture, distribute, install, retail or regulate a range of technologies, they also own and manage homes and supply energy. We take an objective 'whole building, technology agnostic approach' that recognises that there is no single solution to the energy challenges faced by the UK.



Summary of discussion*

Attendees were welcomed by Lesley Rudd, Chief Executive of the Sustainable Energy Association. To set the frame for discussion, an overview was given of the importance of hot water efficiency and why it will become an increasingly crucial part of the home's future energy demand. The efficiency of hot water provision has real significance for the UK's Net-Zero target as domestic water heating is responsible for 4% of the country's CO_2 emissions. Furthermore, as our homes become more energy efficient and we reduce space heating demand, hot water will become an increasingly substantial element of a household's energy bill. The Government recognised this in its consultation on Part L of the Building Regulations where they proposed wastewater heat recovery (WWHR) systems for all new homes and highlighted the role of hot water storage in future-proofing homes for low carbon heating. The Department for Business, Energy & Industrial Strategy (BEIS) has previously stated that the 'electrification of heat requires changes to all gas appliances, and many buildings converting to heat pumps will require additional insulation, hot water storage, and larger radiators'[1]. This clearly emphasises the Government's view that water efficiency should be addressed in terms of carbon savings and cost reduction for consumers. However, the number of homes without hot water tanks has risen substantially following the introduction of combi-boilers. In 1996, 12% of households were without hot water tanks, rising to 54% in 2016[2]. The Committee on Climate Change (CCC) went further in writing that the Department for Environment, Forestry and Agriculture should set a per capita consumption target for water. This should be met 'through water efficiency measures, increased metering, compulsory water efficiency labelling, improved behaviours and more ambitious Building Regulation standards. Water efficiency should be included in energy retrofit programmes as standard' [3].

To date, cooperation between energy use and water efficiency at a policy level has been relatively limited. The Committee on Climate Change have acknowledged this challenge and are increasingly trying to integrate energy and water efficiency, through pieces of work like the UK Homes: Fit for the Future? report. However, participants of the SEA roundtable agreed that collaboration at the level of public policy needs to be stronger to drive a greater focus on the role of hot water efficiency.

HOT WATER STORAGE AND THE WIDER ENERGY SYSTEM

In addition to carbon savings and consumer bills the efficiency of hot water provision also has significance for the broader energy system, as discussed by the first guest speaker of the day, from EDF Energy. The wider energy system is increasingly decarbonised, decentralised, democratised, and digitalised and these four broad trends have ramifications for system flexibility. The decentralisation of the energy system has led to an increase in assets in the market and a fragmentation of generation as larger power plants are decommissioned and replaced with millions of smaller devices. The penetration of green but intermittent renewables into the generation mix poses challenges in balancing demand and supply nationally. However, if their combined potential is maximised, the millions of hot water cylinders in the UK could ease pressure on the grid during peak times by better managing time of use and temperature settings. The UK's smart energy system could be worth £17-40 billion to the economy by 2050 in deferring network reinforcements and build of new generation, and in avoiding curtailment of low carbon generation[4]. Attendees debated whether consumers actually want storage or if in reality all they care about is instant hot water. The general consensus reached was that if customers benefit financially from hot water tanks through new tariffs then demand will grow.

Although in its infancy, energy retailers have now started to offer tariffs that can potentially integrate hot water storage. In Alès, France, EDF installed 600m2 of solar rooftop PV on top of a social housing development with generation used to power communal areas and the hot water tanks of 100 residents. In the UK, Octopus Energy has an Agile tariff giving access to half hourly energy prices based on a time of use model. As the smart meter programme reaches maturity, the number of offerings on the market should grow and homeowners with hot water storage tanks and/or electric vehicles will be ideally placed to benefit from increasingly competitive time of use tariffs. Heat as a Service was also discussed as a potential consumer offer with potential to grow. In Germany, Viessman have integrated heat into a consumer bundle with electricity through their ViShare Energy Community but we are yet to see a large scale commercial example in the UK.

IMPROVING PERFORMANCE OF TRADITIONAL HEATING AND HOT WATER STORAGE

The domestic landscape has changed significantly in recent decades as policy, efficiency improvements and consumer preferences have shaped methods of using hot water. It is thought that financial incentives may well be needed to overcome ingrained consumer and installer behaviour. Vaillant led a discussion on how we can improve performance of traditional heating and hot water storage. Although hot water cylinders were dominant at one time, an increasing proportion of UK homes do not have a domestic hot water (DHW) storage cylinder. Almost 60% of homes rely on combi boilers or other instantaneous sources of DHW[5]. Combi boilers are increasingly popular in new builds where the valuable floor space is used for other purposes and this is compounded by the prevalent installer mind set which favours familiar solutions. Even in large new builds, where hot water storage is particularly appropriate to meet peak demand, it is perceived to be easier to specify a large combi boiler for DHW rather than install cylinders.

Attendees agreed that new build developments are the easiest part of the housing stock to address as changing the Building Regulations is the key to creating more energy and water efficient, low-carbon homes. Improving the regulations to mandate certain technologies would stimulate demand in new builds and lower prices in the retrofit market. As new builds become more thermally efficient energy demand for space heating should decrease but the amount spent on DHW won't necessarily follow. As seen in Figure 1, the Government's proposed revision to the building regulations could see the total impact of DHW on household energy requirements increase by 15%, compared to homes built under the 2013 standards.

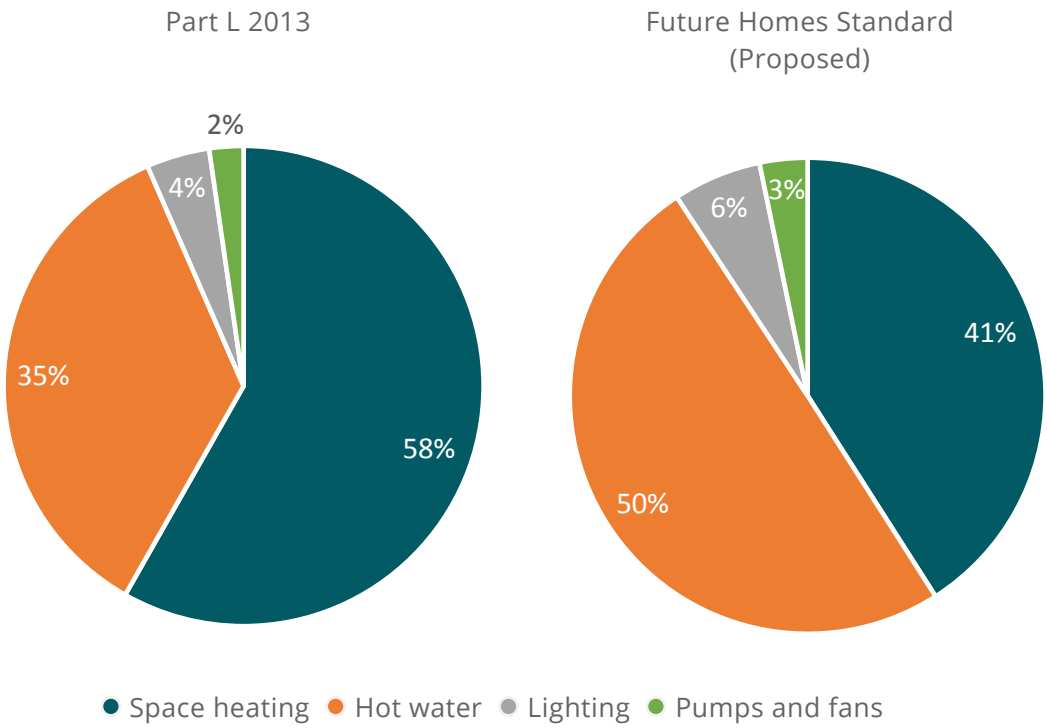


Figure 1: A comparison of household energy requirements

Furthermore, consumer demand could actually increase as the fashion for large 'waterfall' showerheads continues. Educational campaigns have a role to play in encouraging a more responsible level of water usage in the home, and in highlighting the hidden costs.

In existing homes, the airing cupboard is often repurposed during boiler exchanges and once converted the prospect of sacrificing storage space stimulates a lukewarm reaction from homeowners. The space constraint is a serious issue although there are options to overcome this; cylinders could be placed outside the home but these would need to be extremely well insulated and warm to remain effective. There are also technical limitations on the design of cylinders that may affect their adaptability in terms of specification. The larger the storage device, the greater the weight of water contained, and cylindrical shaped storage devices often have the greatest structural integrity compared to other designs.

The switch to combi boilers has been aided by efficiency improvements over time and partially driven by the mandated introduction of condensing boilers. Flue gas heat recovery devices contribute to DHW efficiency improvements but such advances are not exclusive to direct systems. ErP has raised the bar for energy loss requirements of cylinders and although hot water cylinders are ideally suited to low carbon heating their uptake may be limited without greater consumer and installer education. This should be focussed on conveying the benefits for the user and the important role they can play in the wider energy system.

The Boiler Plus policy's requirement for 'secondary measures' including the installation of smart controls has had some positive effects in rolling out smarter technology for heating and hot water. Smart controls can make heating and hot water systems, and indeed the whole house, more efficient creating carbon savings. Discussion at the roundtable highlighted that this could be a first step on the pathway to low-carbon heating including roll out of heat pumps which can be much easier to implement if hot water storage and smart controls are already present in the home. Attendees highlighted the importance of taking the consumer on a journey away from gas boilers to renewable heating which could include hydrogen if the technology comes into fruition in upcoming years. Creating homes that are futureproofed in this way will become more important, as discussed by the next speaker at the roundtable.

FUTURE PROOFING HOMES FOR HEAT PUMPS

As a technology agnostic product, hot water cylinders are incredibly flexible and suited to a range of heating technologies. Mitsubishi Electric UK focussed discussion on the applicability of cylinders to heat pump technology and how homes can be futureproofed for the roll-out of this heating technology which has been suggested to be as high as one million sales of air source heat pumps each year by 2030. Homes that are futureproofed for heat pumps have higher levels of energy efficiency, hot water storage and larger heat emitters. Although the lower flow temperatures (45°C - 55°C) of heat pumps have traditionally necessitated larger coil capacities in cylinders, to compensate some manufacturers have utilised plate heat exchangers. However, a lower flow temperature of does not mean less heat, rather it is a different way of heating the home with cylinders at the heart of the system. Indeed, consumer bills can decrease dramatically when cylinders are heated by a combination of technologies such as hybrid heat pumps with solar PV. Although there are around 460,000 hot water tanks sold annually, this number needs to increase dramatically to futureproof homes as the UK decarbonises heating.

REDUCE AND UTILISING WASTED HOT WATER

Alongside the adoption of low carbon heating technologies, consumer campaigns, new tariffs and changes to building regulations, there are a variety of technologies that can help reduce water usage such as showerhead technology that tracks how much time is spent in the shower, and more traditional measures like water meters. A demonstration of one such technology was given by Showersave who help consumers reduce the amount of energy needed to heat water through WWHR. Showersave's solution places a pipe within a copper heat exchanger to transfer heat energy from outgoing wastewater to the incoming cool water from the mains. Incoming water flows in a pipe wrapped around the wastewater to transfer heat and reduce the amount of energy needed to heat domestic hot water.

WWHR contributes to the alleviation of fuel poverty in the domestic market and it also reduces bills in a wide variety of commercial settings. There is huge potential in premises that use a lot of hot water such as local authority run swimming pools and private gyms. In addition, no additional skills are needed for installation making the technology a simple job for the workforce. Given the improving energy efficiency of new homes and the increasing percentage of energy bills driven by hot water use, mandating WWHR products in new builds could significantly reduce bills and increase SAP scores.

FLEXIBLE ASSETS AND DEMAND SIDE RESPONSE

In the final session of the afternoon, attendees heard from Ecuity Consulting about a practical example of hot water efficiency and its potential for flexibility payments. One current trial being funded by the Government is the Ubiquitous Storage Empowering Response (USER) project, a collaboration of 6 organisations reviewing the feasibility of using hot water cylinders to offer smart grid services via National Grid's Firm Frequency Response (FFR) and negative power prices. The project is being undertaken as part of BEIS' funding for innovative domestic Demand Side Response and immersion heaters provide some of the most rapidly responding, scalable, flexible and cost-effective energy storage available at present. Compared to lithium batteries, hot water cylinders have an infinite charge cycle and can be subject to shallow or deep discharge with no impact on capacity.

The project combines artificial intelligence led optimisation to forecast day ahead energy prices updated every 15 minutes to create a virtual flexible asset that tenders into the FFR market or on the wholesale market during periods of negative prices. The project utilises a smart hub to forecast household level demand and ensure that revenues are shared fairly amongst the virtual community. Projects like this demonstrate that hot water needn't be a drain on consumer finances. Centrica's acquisition of Mixergy demonstrates the seriousness with which the private sector is taking hot water flexibility, and future offerings will build on trials like the USER project. Momentum is increasing so the potential of hot water efficiency should not be watered down; policymakers need to recognise this now.

Roundtable Recommendations

1. FUTUREPROOF NEW BUILD HOMES

As homes become more thermally efficient the significance of water heating in consumer bills will increase. This should be offset by the mandating of WWHR in all new homes. New homes should also include space for hot water cylinders that can operate with a variety of low carbon heating technologies.

2. GREATER SUPPORT FOR INNOVATIVE APPLICATIONS OF DOMESTIC HOT WATER AS A SOURCE OF DOMESTIC FLEXIBILITY

All potential applications of energy flexibility should be explored to mitigate the costs of network reinforcement. Specifically, the Government should commit to funding further specific trials of hot water flexibility and work with industry to create a supportive regulatory environment for such offerings to develop.

3. GREATER COLLABORATION IS NEEDED BETWEEN POLICYMAKERS ON THE ISSUE OF HOT WATER EFFICIENCY

MHCLG, BEIS, DEFRA and other relevant government departments should work together more closely on inter-related issues of water and energy efficiency and the Government should play a lead role in raising consumer awareness on the cost of hot water use.

Next Steps

As our homes become more energy efficient and we reduce space heating demand, the provision of hot water is an increasingly significant part of a household's energy bill. The recent government consultation on Part L of the Building Regulations proposes that new homes should typically have a wastewater heat recovery (WWHR) system and highlights the role of hot water storage in future-proofing homes for low carbon heating. However, new homes continue to be built without WWHR and storage and cylinders are being removed from existing homes. Hot water efficiency is an important issue which required more policy focus. The SEA commits to:

- Support the mandating of WWHR.
- Continue to advocate that futureproofing and a holistic approach must be considerations for new builds.
- Collaborate with government departments, the CCC and other parties to highlight the importance of hot water efficiency and to urge government to raise it up the agenda.
- Continue to explore opportunities and models for heat as a service.
- Advocate smart and flexible homes i.e. DSR that can adapt to the grid and consumers changing needs.
- Urge BEIS to reflect the importance of hot water storage and efficiency in the heat roadmap it is developing.
- Work with consumer groups and organisations like the Energy Saving Trust to try and encourage behaviour change regarding hot water.
- Discuss meeting up with attendees of the roundtable and others who expressed an interest in attending topics potential for a follow up event.

*Please note that the recommendations contained in this report do not necessarily reflect the views of all those represented at the roundtable.

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