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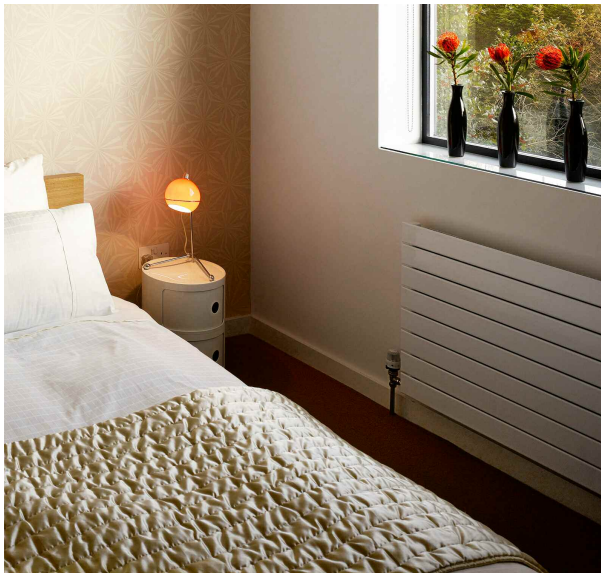
Mitsubishi Electric Guide to Heating and Hot Water Provision in New Build Homes



Information Guide 61

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Mitsubishi Electric Guide to Heating and Hot Water Provision in New Build Homes

This is an independent guide produced by Mitsubishi Electric to enhance the knowledge of its customers and provide a view of the key issues facing our industry today.

This guide accompanies a series of seminars, all of which are CPD certified.

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The housing challenge - overview

The provision of homes in the UK is a highly political topic because public demand for housing has been outstripping supply for some years.

The Barker Review of Housing Supply (March 2004) predicted that the UK would need to ensure delivery of around 250,000 new homes per annum to prevent a shortage of affordable homes.

Unfortunately, figures show that this has not been achieved. The recession that began in 2008/09 saw a massive fall in the completion of new homes - from a total of 219,000 in 2006/07 down to 137,440 in 2010/11. But even without the recession, figures from The Department for Communities and Local Government (DCLG) on completed permanent dwellings show a steady decline since their records began, from 378,320 homes completed in 1970 to just 140,960 in 2014.

More recently, a report published by consultants KPMG*1 said that affordability and accessibility were major issues in the UK housing market. Jan Crosby, head of housing at KPMG, stated: *"Politicians need to develop an apolitical, long-term housing strategy engaging both public and private sectors, to get the UK building and stabilise our housing market."*

*1 'Building The Homes We Need' KPMG and Shelter, 2015.

Governments across the political spectrum in the past fifteen years have emphasised the need for more new homes to be constructed, and on the 1st September 2015, Planning and Housing Minister Brandon Lewis publicly committed to delivering 1 million new homes by 2020.

There are a number of schemes in place to help achieve that number. For example, local authorities are targeted by the New Homes Bonus scheme, which will reward Local Authorities for delivering new homes in their area.

The private sector continues to be the mainstay of the UK housing market, and the Government has pledged £100 million through the Housing Growth Partnership to support small private builders.

New buyers are also being supported financially. For example, the Help to Buy scheme which was launched in 2013 and which supports first-time buyers with assistance on a deposit payment for a home and mortgage guarantees. Alongside these incentives are other moves, such as ensuring that planning permission for new homes is easier to achieve.

Overall, the drive is very much to revitalise the new homes sector of the UK.

But in these days of environmental concerns, it is not simply a case of supplying homes for families and individuals. Dwellings must meet increasingly stringent standards on energy efficiency and air tightness set out in the Building Regulations, particularly Part L, which deals with the conservation of fuel and power in buildings.

Providing comfortable and efficient homes

The UK is aiming to reduce its greenhouse gas emissions by 34% by 2020 (against 1990 levels) with a further goal of 50% by 2025.

Buildings are a key part of this reduction strategy, as they account for 44% of all UK CO_2 emissions - more than industry or transport. Space heating and hot water are major energy users, accounting for around 75% of the total energy consumed in UK homes. Technologies and techniques which can reduce emissions while not slowing the construction of new homes are therefore vital for future house building success.

It is also important to note that more attention than ever is being paid to occupant comfort and health in new homes. In compliance with Part L (2013) of the Building Regulations, new homes are highly insulated and air tight. Poorly fitting windows and doors are not permitted - and as a result the influx of fresh air into a new home is potentially far less than its counterparts of twenty years ago, so designers must deal with this as a potential indoor air quality problem.

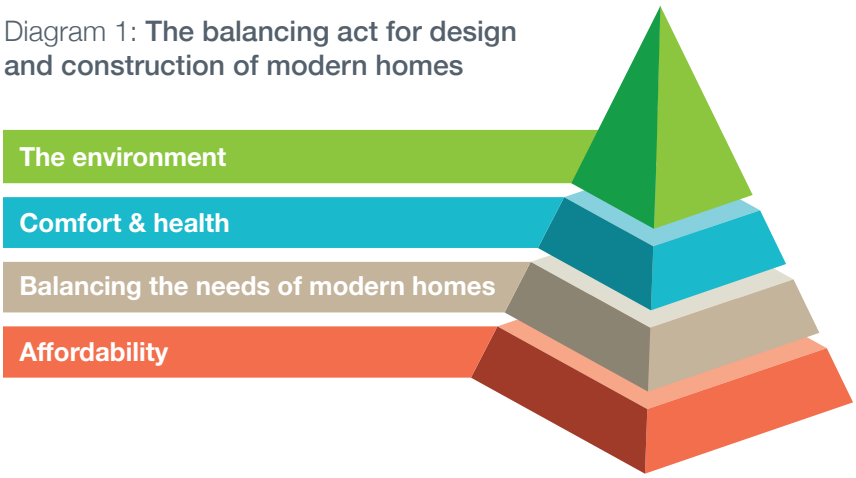
The UK Housing Energy Factfile (2013)*2 highlighted just how much homes in this country have changed in the past fifty years. The report comments: “Most families in 1970 lived in homes that would be cold by modern standards in winter - as cool as 12ºC on average. There may have been ice on the insides of the windows and nearly everyone accepted the need to wear thick clothes at home in winter.”

Today’s homes are very different from those constructed in the past, and occupants have different expectations of comfort. Looking forward over the next two or three decades, houses will continue to change in response to tighter legislation and occupant requirements. As a result, we need to re-think the building services technologies that are used in the houses being built today.

*2 Housing Energy Factfile 2013. Authors: Jason Palmer, Ian Cooper. Prepared for DECC and published in December 2013.

We can regard the construction of modern homes as something of a balancing act, which must offset the requirement for a large building programme with the need for comfortable, energy efficient homes which are also affordable to buy and which ensure household expenditure on heating and hot water are kept to a minimum.

Diagram 1: **The balancing act for design and construction of modern homes**



Access to the gas grid

The notion of fuel affordability is an important one. Building one million new homes will require construction in geographical areas where homes do not already exist. On the 28th January 2015, the Government announced a multi-million pound fund to deliver 200,000 new homes on brownfield sites across the country. This means that many of the new homes are very likely to be off the existing gas grid.

According to figures from the DCLG around 10% of homes in the UK are currently off the gas grid, amounting to just over 2,600,000 homes in 2013. It should be noted however, that even the Government has no firm figures on this situation, and makes its estimates based on the number of registered meters against number of households on the National Census. Other figures are much higher, for example consumer magazine “Which?” puts the figure of those households that are not on the gas network at 4 million in 2014.

This fact means that builders must consider carefully how householders are going to heat their homes. Fuel poverty is already an issue for many consumers, so the provision of reliable and affordable (in the long-term) heating and hot water systems cannot be overlooked.

Achieving energy efficiency

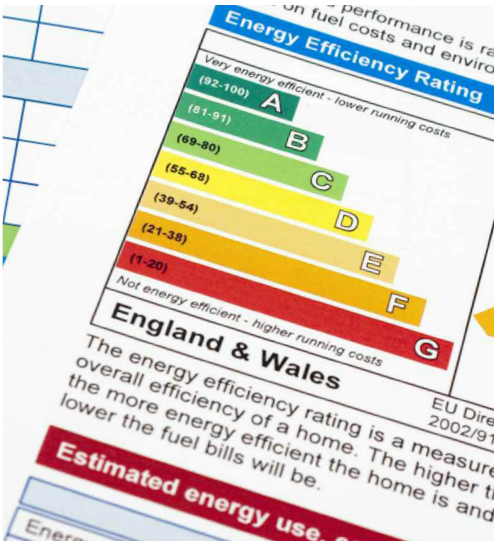
Part L (2013) of the Building Regulations has already been mentioned. This important regulation has five key requirements that housebuilders must meet in new build dwellings.

- Requirement 26A requires dwellings to achieve or better a fabric energy efficiency target in addition to the carbon dioxide target.
- Regulations require an overall 6% CO_2 savings across the new homes build mix relative to Part L 2010.
- The feasibility of high efficiency alternative systems must be taken into account before construction commences. These systems include heat pumps.

As well as these requirements for the building itself, reasonable provision to conserve fuel and power through the following means must also be shown to be considered:

- Limiting heat gains and losses (through good insulation of roofs and walls).
- Providing fixed building services which are energy efficient; have effective controls and are commissioned and adjusted to optimise power consumption.

An integral element of Part L is the SAP rating of a new home. This is the Standard Assessment Procedure which is the Government-approved method for assessing the energy efficiency of a new home. Assessments are carried out by accredited professionals at the design stage of a new dwelling, and any new home must pass the SAP rating or the house cannot be sold or let.



SAP ratings are based on a number of factors which include how well the fabric of the building retains heat; solar gain; and quality of construction and commissioning of systems. A higher SAP rating (100 is the highest) means lower running costs for householders.

The characteristics of a dwelling with a good SAP rating include a high efficiency heating system, and a high quality building fabric with low U-values which are also well installed. Thermal bridging - heat loss through junctions with external walls - must also be minimised. Air tightness is absolutely key and all new build homes should pass an air permeability test. The results of this test are an important part of the SAP calculations.

Use of renewable technologies such as heat pumps, and Mechanical Ventilation with Heat Recovery (MVHR) technology make compliance with building regulations, and achieving higher SAP ratings much more likely. The reduced carbon emissions from using renewable technology will help a building design achieve a lower carbon emission rate than the maximum allowable emission rate ($kgCO_2/m^2/year$) in the SAP calculation. From October 2013 to the end of December 2013, the average SAP rating of new homes in the UK was around 80.

The effect of legislation on the design and construction of modern homes cannot be underestimated. Over the past forty years, the number of households has increased 44% from 18.8 million to 27.1 million. In spite of this rise, heating energy use across UK homes has only increased by just over 10%. Also the rate at which homes lose heat during the heating season has fallen from 376W/ºC in 1970 to 290W/ºC in 2013.

The required improvements in legislation and heating systems have clearly helped to ensure that our homes are warmer, but also that their impact on the environment has been reduced. What's more, legislation will continue to require improvements in fabric efficiency, insulation and air tightness.

According to the Housing Energy Factfile 2013:

"There is no evidence of a plateau in average SAP ratings. These ratings are a good barometer for home energy efficiency and further improvements in insulation and heating efficiency will inevitably push average SAP ratings higher."

The modern home - a changing environment

The modern home is very different from its counterpart built in the 1970s. It is essentially better built and more comfortable for occupants because of legislation to save energy and reduce CO_2 emissions.

Now, as the UK Government encourages the rapid increase of the stock of new homes, there are other factors changing the characteristics of the modern home.

The shape and type of new homes are very much influenced by consumer demand. As a result, we are seeing that household sizes are falling and at the same time the number of households are rising. Also, the concentration of households is moving away from the North of England to the South West, Midlands and the South. Flats and detached homes together make up more than a third of the modern building stock - and look set to remain the largest proportion of new home types.

Space heating has always been the largest proportion of energy use in older, existing UK homes, and this looks set to continue. Even though homes have become better insulated and more energy efficient, today's householders prefer their homes to be warmer than those of previous generations. As a result of changing preferences, the percentage of energy used for space heating has grown from 58% to 62%.

However, space heating is a reducing requirement in modern homes. Flats, which are now 20% of the building stock, have lower heat losses. And although detached homes (now 17% of the stock) are more liable to heat loss, Part L of the Building Regulations has improved fabric insulation so much that heat loss has been greatly reduced.

According to the Housing Energy Factfile 2013, there has been a long-term downward trend in requirements for heating - the UK has cut energy use for heating by a fifth since 2004. Less harsh winters and rising energy prices have played a part in this trend.

Overall the modern home requires less space heating than in the past. The requirements for air tightness have played a significant role in this change. Reducing 'leakage' of heat from a dwelling greatly reduces the need for space heating. According to BRE, a house achieving an airtightness of 5m^3/hour will use 40% less energy than a house that is built to air permeability of 10m3/hour. Under Part L of the Building Regulations, 10m^3/hour is recommended in the legislation, however house builders can avoid the requirement for airtightness testing of new homes by using a standard 15m^3/hour in their Part L calculations.

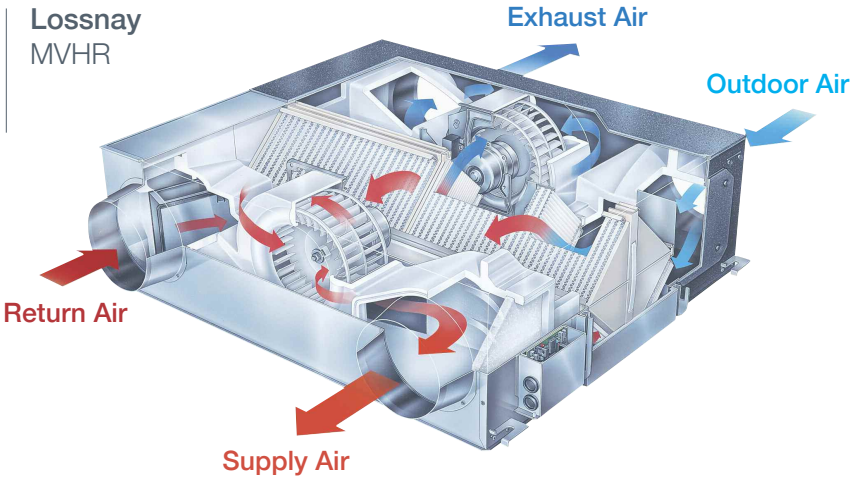
The new rules on airtightness mean that careful consideration must be given to how indoor air quality can be assured in new homes. Ventilation is required to ensure good indoor air quality by removing stale, moist air caused by cooking and bathing. Occupant health can be badly affected by damp air. In general, the ventilation target for homes is between 0.5 and 1.5 air changes per hour (ach). According to the document '*A practical guide to building airtight dwellings'* produced by NHBC Foundation and the Zero Carbon Hub, a house with airtightness of 10m^3/hour will achieve around 0.5 ach without further ventilation.

Mechanical ventilation is now required under Part F of the Building Regulations which deals with achieving sufficient 'purpose-provided ventilation'. We return here to the idea of balancing the requirements of dwellings - high levels of air tightness must be offset by ventilation, which in turn must not compromise the permeability of the building. At the same time, by drawing in fresh air there is a chance that internal temperatures are lowered - reducing comfort and increasing the demand for heating.

So the question for designers and installers is how to approach the heating and ventilation of a modern home, while complying with legislation and ensuring that occupants have the type of home they want to live in.

The answer is that a whole-house approach is required. Technologies are now widely available which suit the requirements of the modern home and meet the legislation. In particular, these are **heat pumps** and **mechanical ventilation with heat recovery (MVHR)**.

MVHR works by extracting stale air from the house and bringing in fresh air - while the heat recovery element means that the incoming air does not reduce the internal temperature of the house.



MVHR is a simple but effective approach to ventilation that is recognised as the most energy efficient way to balance the need for fresh air with the requirement to retain heat within the house. **Using this alongside a heat pump provides outstanding energy efficiency and occupant comfort**.

Alternatives to the traditional approach

The majority of UK homes now have gas-fired central heating.Those built in the last ten years probably have some form of mechanical ventilation in areas such as bathrooms. For those houses which are built off the gas grid, electric heating is most often the alternative to a boiler-and-radiator approach.

Although these approaches have been adequate in providing the heating and hot water required, there are now well-established technologies that can be considered to the benefit of occupants and installers alike.

The new tranche of one million new homes will require new thinking about building services provision if the UK is to keep on target for reducing CO_2 emissions and ensure that the homeowners can keep their fuel bills to a reasonable level. This is particular true if the new homes are to be built in off-gas grid areas where alternatives such as oil are to be discouraged for environmental reasons.

Heat pumps are a well-known and widely used technology that offer excellent characteristics that are particularly suitable for the modern dwelling. Heat pumps offer outstanding energy efficiency because they provide good space heating with highly efficient production of hot water. This very much reflects the changing heat profile of new homes, where hot water demand is likely to outstrip requirements for space heating.

There is another very good reason to consider the heat pump as the technology of choice for new homes - the Energy Related Products Directive (ErP). The ErP Directive relating to heating (space and hot water) equipment came into force on the 26th September 2015. From this point it was illegal to manufacture or import into the EU products which do not meet the new criteria *(full details of the ErP can be found in the Mitsubishi Electric Guide to the ErP)*.

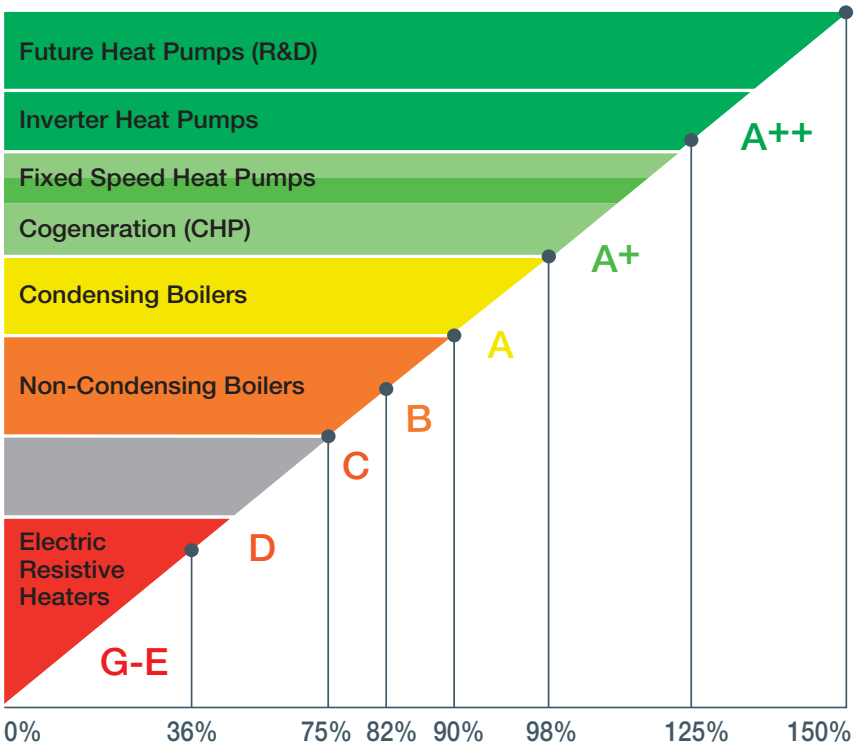
Alongside new minimum standards that manufacturers must meet, the ErP introduces an energy labelling scheme which is based on Seasonal Space Heating Energy Efficiency (SSHEE). This is a very important aspect of the ErP as labels are intended to provide consumers with clear information on product performance, and to allow them to make easy comparisons between different types of product.

Overall, this new labelling will be a clear demonstration that heat pumps are extremely energy efficient - even compared to the latest condensing boiler technology.

Diagram 2 opposite shows how technologies compare

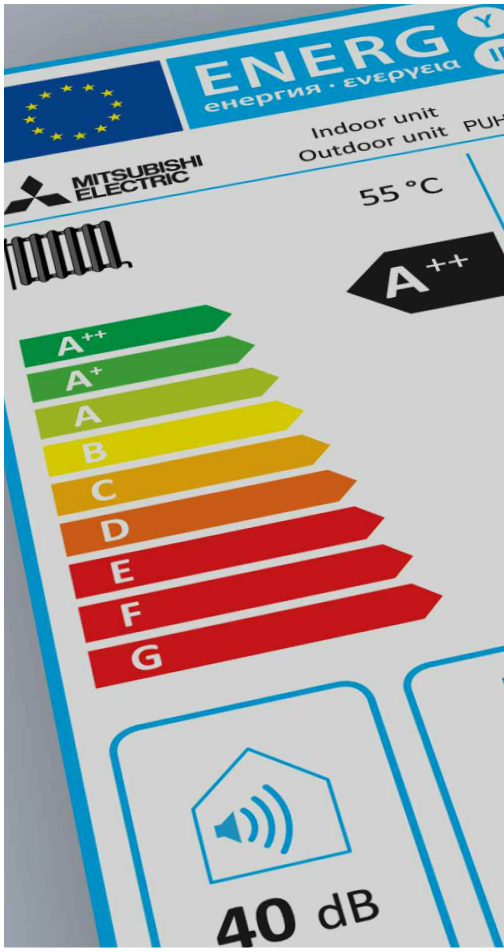
Ecodan QUHZ
Air Source Heat Pump

Diagram 2:



As well as offering a robust technology that conforms with the very latest efficiency requirements, heat pumps offer a number of benefits for householders. The heat pump system looks very much like the traditional boiler approach. Radiators are the same size, for example, and installation techniques are also very similar. A heat pump system is able to provide plentiful hot water for a household as we would expect from a traditional boiler. It is also possible to use a heat pump in combination with other approaches such as underfloor heating.

From the installer and builders point of view, heat pump technology costs the same to install and there is now a broad range of types of heat pump, giving excellent choice when it comes to equipment selection. What's more, heat pumps work well for apartment buildings and for detached homes - which are the most common dwelling types. Heat pumps come in a range of sizes and capacities, so they can be applied to a wide range of dwelling types. They are also extremely quiet in operation. The ability to apply the same technology across a mixed-type housing development is another benefit to developers looking to reduce their costs.



Conclusions

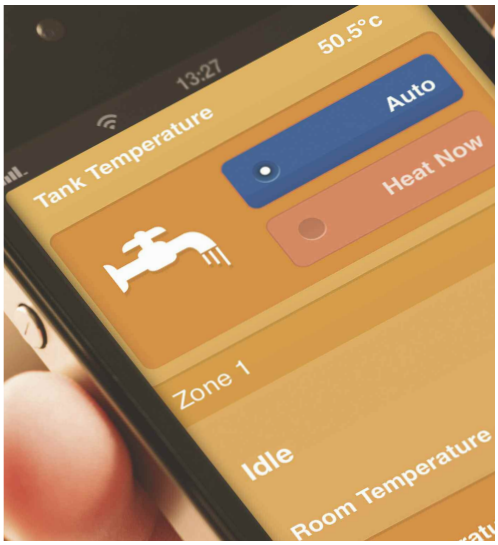
Building hundreds of thousands of new houses is a golden opportunity to change the way we heat and provide hot water in our homes. We can make a great impact on UK CO_2 emissions by considering alternatives to traditional heating systems and ventilation techniques.

Since the 1970s, consumers have experienced enormous leaps in the technology we use in our everyday lives. From high definition televisions and mobile phones, to home computing and the Internet - these new technologies have been embraced and are now widely used.

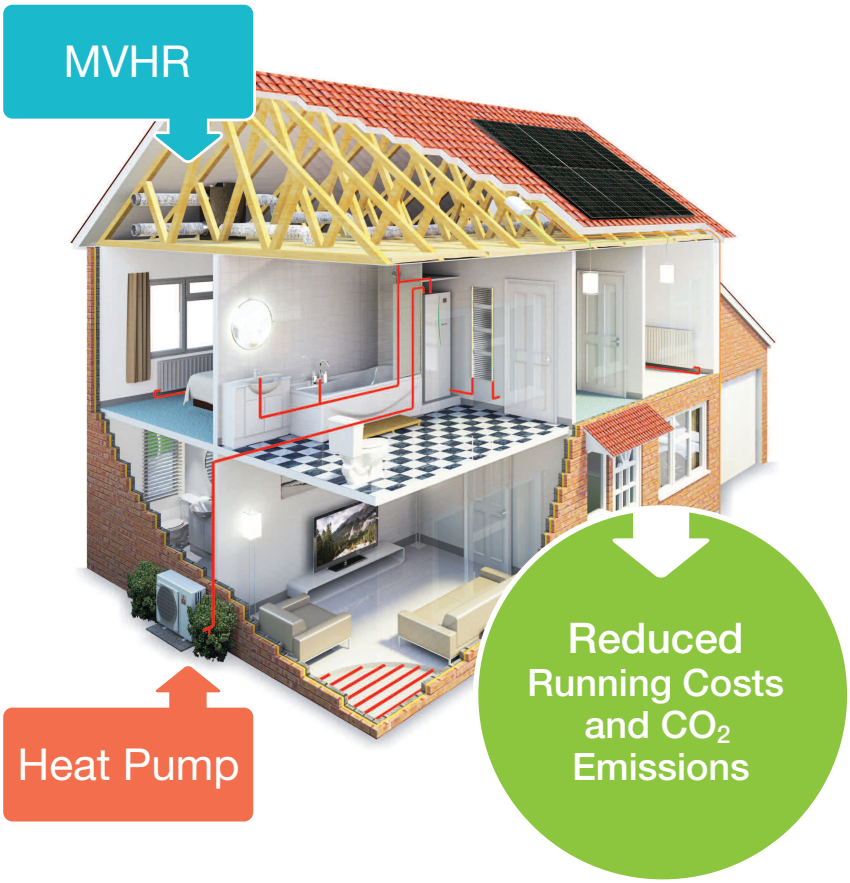
However, most homeowners are still faced with minimal choices of technology when it comes to heating their homes and providing hot water - a gas boiler or perhaps electric radiators. While boiler technology may be more efficient than forty years ago, we have to ask if it will answer the requirements for the houses we are looking to build right now.

As the places we build change more to off-gas grid brownfield sites, the approach to domestic heating has to change to take into account the design and construction of modern homes. Heat pumps are no longer 'new' - they have been on the market for some time and the technology has been widely tested and proved.

As we move into another decade of high volume home building we are faced with an opportunity to shift the building services technology in our homes to a more modern and future-proofed approach.



By applying MVHR alongside heat pump heating, which fits the profile of homes that need less space heating, installers can ensure that occupants are not only comfortable but also that they have an affordable and modern system in their homes that will provide a level of energy efficiency that will benefit them into the long-term.



References:

Housing Energy Factfile 2013
Authors: Jason Palmer; Ian Cooper
Prepared for DECC and published in December 2013

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