

## **Explore the creation of a public/private delivery for domestic/commercial heat pump installation, targeting oil-fuelled premises first.**

### **1. EXECUTIVE SUMMARY**

- 1.1. The single biggest sector, by emissions figures, is heating of buildings.
- 1.2. A heat pump sounds complicated but is no different to a household fridge, (which is also a heat pump, in reverse) but in this case moves heat around and can be three times more efficient than an oil or gas boiler.
- 1.3. Heat pumps are likely to be an important part of meeting 2050 carbon targets.
- 1.4. Boilers have a lifespan of 15+ years, so a replacement rate per year of 2,000-2,500 could be expected, roughly half and half oil and gas boilers.
- 1.5. Key barriers to achieving the required level of uptake include cost, awareness, confidence, suitability and installer capacity.
- 1.6. There may be scope to develop a Framework Agreement route to procure air source heat pumps (ASHP), leveraging economies of scale for Public Sector Housing as was developed for the Ayre View trial (Bevan, 2009).

### **2. THE CHALLENGE**

- 2.1. Overview of the energy consumption profile and emissions inventory of the Isle of Man.
- 2.2. There is now a good understanding of the main sources of emissions from the Isle of Man, simply put total emissions, (expressed as carbon dioxide equivalent CO<sub>2e</sub>) is circa 800,000t CO<sub>2e</sub>, equating to a per capita figure of circa 10t per person. The objective of reducing this to a Net-Zero figure (from 1990 levels) by 2050 will be challenging, but consistent with the UK's targets (DEFA, 2016). The Climate Challenge Mitigation Strategy usefully breaks down targets per sector and milestones to aim for, notwithstanding need to upgrade existing building stock, and de-carbonise electricity supply over the longer term.
- 2.3. Broad splits are between:
  - Electricity generation (responsible for 199,000t of total emissions = 24% of emissions in 2016).
  - Heating of homes, businesses and other buildings (domestic combustion alone was responsible for 286,000 tonnes or 34% 2016).
  - Surface transport (meaning fuels for vehicles such as cars, lorries, buses) (responsible for 158,000t or 19% of emissions in 2016, but excludes

emissions from aircraft and shipping.

- Land use practices (responsible for 98,000t or 12% of the Island’s emissions in 2016, although there is an estimated 17.45M tonnes of carbon dioxide locked up in soil in the form of carbon in peat and soils). Further details are covered within Work Packages 4, 5, 6, 16.
- The single biggest sector, by emissions figures is space heating of buildings including domestic properties. Means to address this topic are further discussed in Work Packages 8 and 9.

2.4. To reach the goal of reaching net zero emissions, there will be an expectation that energy sources including home heating will largely move from fossil fuels to renewable energy. This renewable electricity could also be used to power an ASHP.

2.5. New properties are significantly more energy efficient than older properties. The Isle of Man Government carries out periodic (Private Sector) House Condition Survey work on a sample size of approximately 1,500 properties every 10 years. (Milne, 2019) Included within this is an energy efficiency metric. The energy metric is the Standard Assessment Protocol (SAP) for energy performance rating, which ranges from 1-100. The higher the number the better the energy performance rating.

2.6. The age of a home is strongly associated with its condition and energy performance. The oldest homes (pre-1919) generally perform less well in these respects than newer homes. Private sector housing in the Isle of Man is representative of all building eras but is predominantly of post Second World War Construction. The table below is data from 2008 Private Sector House Condition survey. There is a further ~7,000 Public Sector homes meaning aggregate number of homes is ~42,000 in total. (Hall, 2008)

Table 1: Age profile of housing in the Isle of Man.

Age cohort	pre 1919	1919-- 1944	1944- 1981	1981- 2008
Number of homes	7,490	2,745	9,596	15,321

2.7. Just over half of private sector dwellings use mains gas as their primary heating source, with a further 41.9% relying on oil. The overwhelming majority of dwellings (93.7%) have a boiler for heating, with the remaining properties relying on a range of heating including electric storage heaters, heat pumps, wood burning stoves, community heating and room heaters.

2.8. Based upon the stock condition data, the estimated average SAP score for private sector dwellings in the 2019 survey on the Isle of Man is 54, compared to a 2008 Survey figure of 53, notwithstanding that the methodology has been modified during

the past 10 years (Milne, 2019). There is little difference between tenures, with the average SAP for owner-occupiers being 54 and for privately-rented dwellings 56. Dwelling age has a significant impact on the average SAP score, such that dwellings built post 1981 exhibit an average SAP score of 66 compared with 42 for dwellings built pre-1919. The type of primary heating fuel also impacts upon average SAP scores, with dwellings utilising bulk Liquid Petroleum Gas (LPG) possessing the lowest SAP scores and properties heated by mains gas the highest.

- 2.9. Fuel poverty has been measured based upon the 10% definition, whereby any household required spending more than 10% of their annual household income on modelled running costs are said to be fuel poor. On this measurement 4,000 private sector households (11.6%) are estimated to be in fuel poverty. There is little difference in the rate of fuel poverty between tenures, but households occupying dwellings constructed post 1981 are significantly less likely to be in fuel poverty (5.8%) compared to those in pre 1919 properties (21.3%) (Milne, 2019)
- 2.10. Households utilising heating oil are the least likely to be in fuel poverty 5.7% whilst those reliant on electricity or mains gas are more likely to be in fuel poverty 27.4% and 14.6% respectively. Probably the way to go is to aim for improvements to energy efficiency of properties then look at more efficient heating systems (unless properties are already well insulated). Measures to drive fabric improvements for domestic – air tightness, insulation etc would seem to be a gap. This is the basic principle for heat pump installation i.e. the property (if suitable) is made as thermally efficient as possible to both reduce the number of radiator modifications/replacements required and the overall size of the heat pump. Fuel Poverty remains an issue – homes heated by oil are not as severely impacted as those on gas/electric as heating sources.
- 2.11. Over two thirds of private sector properties are of cavity construction, with a further 21% being solid stone, reflecting the conventions of different building eras. In terms of wall insulation, house condition surveyors concluded it was present in approximately a third of dwellings and absent in over 50%, although in another 15.8% it was not feasible to indicate either way (Milne, 2019).

**Main Roof**

INSULATION DEPTH	Pitched		Flat		Other Dwelling Above		Total	
	Count	Column %	Count	Column %	Count	Column %	Count	Column %
None	1880	5.7	42	9.0	0	0.0	1922	5.6
12mm - 75mm	2843	8.6	31	6.6	0	0.0	2874	8.4
100mm - 200mm	15418	46.8	103	21.7	0	0.0	15520	45.5

250mm+	5555	16.9	0	0.0	0	0.0	5555	16.3
No Access	679	2.1	0	0.0	0	0.0	679	2.0
D/K	6567	19.9	297	62.7	0	0.0	6864	20.1
N/A	0	0.0	0	0.0	679	100.0	679	2.0
<b>Total</b>	<b>32941</b>	<b>100.0</b>	<b>474</b>	<b>100.0</b>	<b>679</b>	<b>100.0</b>	<b>34093</b>	<b>100.0</b>

**Walls Insulated**

Main Wall	Yes		No		D/K		Total	
	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %
Solid Brick	161	13.8	833	71.4	173	14.8	1167	100.0
Solid Stone	1140	16.0	5785	81.2	203	2.8	7127	100.0
Cavity	9328	39.6	9440	40.0	4807	20.4	23574	100.0
Timber Frame	937	53.9	657	37.8	145	8.4	1740	100.0
Other	70	14.3	373	76.9	42	8.8	485	100.0
<b>Total</b>	<b>11636</b>	<b>34.1</b>	<b>17087</b>	<b>50.1</b>	<b>5370</b>	<b>15.8</b>	<b>34093</b>	<b>100.0</b>

**3. THE OPPORTUNITY**

- 3.1. A close to full decarbonisation of heat production in the building sector is likely to be required to meet the UK’s 2050 greenhouse gas reduction target cost effectively. Analysis carried out for the UK’s Committee on Climate Change (CCC) (UK Committee on Climate Change (CCC)) and others suggests that rollout of heat pumps is likely to form a major part of a cost effective decarbonisation of the heat sector (UK Committee on Climate Change (CCC), 2013). This is even more relevant to the Isle of Man context given that heating of buildings is the single largest source of greenhouse gas emissions, and will remain so until a step change in buildings energy efficiency and means of heat provision is tackled. There is an interim measure of introducing natural gas blended with biogas or other green gases - <https://www.greengas.org.uk/green-gas> (2019)– the latter could be sourced from either landfill or Anaerobic Digestion – the latter being considered by Work Package 21.
- 3.2. An Air Source Heat Pump (ASHP) is an electric boiler that uses heat energy in the ambient air to heat water, effectively operating as a fridge (or air conditioning unit) in reverse. Ground Source Heat Pumps (GSHPs) are an alternative, but have more complex installation requirements due to ground work preparation. A modern ASHP has a thermal efficiency of 300% (as much of the heat energy is extracted from the

surrounding air) compared to 90% for a modern gas boiler. There are also options to merely heat air, rather than distribute heat by warmed water, an Air to Air Heat Pump rather than Air to Water. These options are more familiar on continental Europe and rarely found in the UK, but is worthy of consideration, assuming the expertise and experience exists in the local context.

- 3.3. A recent iteration of the technology is to provide a “Hybrid” boiler combining ASHP with a conventional Oil/Gas boiler. In this scenario, the heat pump operates as the base load heating source and the gas/oil boiler is only switched on for exceptionally cold winter days when the heat pump(HP) is operating close to its maximum capacity. This has a beneficial impact for the local supplier who can partly delay any major network reinforcement or provide an innovative ‘interruptive’ electricity tariff to encourage fuel switching by the householder. HPs combined with thermal storage will also help in this respect. This may be suitable in circumstances where an ASHP cannot provide all the space heating needs throughout the year. However, this would not resolve the issue of being reliant on a fossil fuel as part of the homes heating requirements. For hot water, there are also ASHP supplemented by solar thermal, but probably less relevant in the Isle of Man’s context than say Mediterranean countries.
- 3.4. The UK CCC note that the roll-out of heat pumps by 2030 is projected to be below the critical path (noting the report this comes from dates from 2013) these factors remain valid in 2019 and also being mindful that the Isle of Man does not have some of some the supportive measures such as Renewable Heat Incentive, the Green Deal finances etc. the UK are set to release new policy mechanisms in this area and ASHP have been highlighted by the CCC as one of the key technologies required to decarbonise (UK Committee on Climate Change (CCC), October 2013). National Grid Future Energy scenarios set out different HP rollout rates to meet various green targets. Their most ambitious scenario known as ‘Two Degrees’ when normalised for the Isle of Man’s household numbers indicate that around 10,000 heat pumps would need to be installed by 2030 (National Grid, 2018). Given that Public Housing stock is sizable at ~7000 properties (effectively one in six homes), with ongoing management and maintenance ultimately the responsibility of Local Authorities and Department of Infrastructure via Treasury funding, as a cohort this would be a plausible sector to focus on focussing roll out of Heat Pumps, and if converted to Heat Pumps, this would go a long way to meeting the 2030 target of deployment of 10,000 homes heated by Heat Pumps. Currently the baseline is approximately 200 HPs on the Island and therefore annual compound growth rates of over 40% is required to achieve this by 2030.
- 3.5. Although the Isle of Man does not currently have an equivalent Renewable Heat Incentive (RHI) financial incentive scheme, gas prices on the Island average 8p/kWh versus that of the UK’s of approximately 4p/kWh – and approximately 85% of the UK residential heating sector is supplied by natural gas.

- 3.6. The UK heat pump market currently sees around 20,000 installations per year, primarily of domestic air-source heat pumps (ASHPs). This compares to around 1.6 million gas boilers installed per year. Heat pump installations have generally been focused on well-insulated homes seeking a replacement for oil-based heating. Experience from the UK's RHI scheme (UK CCC, October 2013) was that only when a heating system reaches end of life would householders will look at the available technologies. If the system is broken householders are more likely to opt for a like for like replacement, a "distressed purchase".
- 3.7. Key barriers to achieving the required level of uptake include cost, awareness, confidence, suitability and installer capacity. There is a particular difficulty of retrofitting to existing buildings. Heat Pumps require low temp heat distribution systems for optimal performance, most existing central heating heat distribution systems aren't ideal for heat pump applications.
- 3.8. The high capital cost of heat pumps relative to the conventional gas boiler alternative is a major barrier to uptake in existing homes on the gas grid. This cost differential isn't the only major barrier. Often energy efficiency and other improvements will be required. These, combined with the costs of equipment, pose quite a challenge. In new build homes there has been a lack of uptake due to the relatively high costs of heat pumps, and the fact that they are not currently needed under building regulations.
- 3.9. Another barrier to uptake has been consumer confidence. In particular performance of heat pumps has sometimes been below expectations, resulting in a lack of confidence among consumers. Consumer awareness around heat pumps is also limited and represents a barrier to uptake.
- 3.10. Looking forward, rapid scaling of demand could cause a number of bottlenecks in the supply chain. This would also be relevant for the Isle of Man, but probably not a significant challenge for the next decade as Island electricity demand has reduced by 10% since its peak in 2009 due to the introduction of LED lighting and energy efficient domestic appliances. As self- generation from solar photovoltaics (PV) becomes more affordable, electricity supply is not expected to be a major stumbling block. Encouraging thermal storage, overnight heating and load management services will also defray network reinforcements for the next decade.
- 3.11. Around half of all homes in the Isle of Man use oil as their primary space and hot water heating fuel. This equates to over 20,000 homes. Given a lifespan of a boiler being on average 15+ years this equates to a replacement rate of 1,300-2,000 boilers per year. It is also noted purchasing a boiler is often a "distressed" purchase, i.e. one taken when a boiler unexpectedly breaks down and needs urgent repair or replacement, and hence a patched up boiler may continue in usage for an extended period, so numbers of boilers replaced per year may be an over-estimate.

- 3.12. If gas heated homes were included the uptake rate would need to broadly double. Carbon dioxide emissions from oil boilers are significantly higher than from natural gas as a boiler fuel.
- 3.13. Given the need to reduce the Isle of Man's reliance on imported, green-house gas producing fossil fuels, options for achieving reductions in these homes need to be considered as a priority. Homeowners can reduce emissions and lower their ongoing energy bills by improving household energy efficiency and/or by changing how their heat requirements are met. This work package focusses on the potential impacts of a long term transition to heat pumps as an alternative energy source to oil. The household level economic considerations of a move away from oil are estimated as well as the system-wide impacts of a large scale switch. Heat pumps offers an opportunity to reduce greenhouse gas emissions in the heat sector while increasing renewable heat production, via heat pumps, thereby contributing to the Isle of Man's net zero emissions aspirations.
- 3.14. The most cost effective way for most householders to reduce ongoing energy bills is by investing in building fabric upgrades e.g. upgrades to roof and wall insulation, draught proofing, changing to triple glazed windows etc. From a policy perspective consideration of the costs and benefits of improvement to building fabric need to be compared to those estimated for a shift to a broad scale roll-out of heat pumps. This topic is covered in further detail in work packages 8 and 22. Thermal insulation investments will benefit the householder both in terms of a smaller and therefore cheaper heat pump but also lower running costs over the 15-20 year life of the heat pump.
- 3.15. To identify effective policies, the CCC report (UK Committee on Climate Change (CCC), 2013) started from the list of key barriers and identified a range of policies that could address each one. These policies were then filtered against a set of criteria, including effectiveness in tackling barriers, flexibility, risks, distributional impacts and impacts on cost dynamics. Finally, international policies were reviewed to draw in relevant learning.
- 3.16. The 2013 CCC report modelled that by removing all non-financial barriers to uptake such as awareness, confidence, hassle, time to research technology and performance the uptake rises from 20,000 per year to 2.1m heat pumps per year by 2030. Latest 2019 National Grid 'Two Degrees' energy scenario suggests c2.5 million ASHPs by 2030 (5.7 m by 2050). So financial barriers are the biggest obstacle to achieving the circa 7m heat pumps consistent with the "cost-effective" path. In an Isle of Man context the same non-financial and financial barriers also apply, so a co-ordinated programme of works would be required, inspired by lessons learned by UK CCC programme. It is worth noting that UK's heat pump numbers normalised for the Isle of Man forecasts a figure of 272 HPs installed on the Island by 2020. Actual numbers on the Island are expected to be around 250 despite lack of financial incentives, minimum public awareness campaigns, etc.

3.17. The relevant policies through this process, and following analysis of the work of the CCC comprised of:

- Enhanced certification (requiring installer and consumer training) with sustained information campaigns. This includes requirements on training of heating installers as well as training of consumers by installers – very relevant for the Isle of Man.
- Heat pump uptake in new homes would need to be stimulated through tightening new build energy/carbon standards (or requiring Passive House compliance).
- Capital grants. This is a “one-off” upfront payment to consumers to offset the capital cost of heat pumps. There is currently only very modest energy grants for householders, which is means assessed and is due for revision due to low uptake. Potentially, could offer heat pumps at reduced VAT (5%) and allowing a one off 10/20% income tax deductibility on the upfront capital costs or future running costs.
- Loan guarantees and social finance. These improve the access to finance for consumers installing heat pumps. One variant is a Green Deal-style loan at a real 7% interest rate. The second is an idealised ‘social financing’ measure where consumers receive loans at a social discount rate (3.5%) and invest if the return on investment exceeds this rate. Island banks may be interested in getting involved to enhance their CSR/Sustainability credentials. There may also be scope for “green mortgages” with finance companies such as HSBC and Barclays to reflect the reduced utility costs allowing increasing mortgage spend on green products/services see Barclays - <https://www.mortgageintroducer.com/barclays-launch-uks-first-green-mortgage/#.XZXHcclKhyw> . Green Deal is not available on the Isle of Man, although the Manx Credit Union <https://www.mcu.im/> is comparable to the social finance model described above. One of the major failures in the Green Deal was that the interest rates were not competitive with the wider finance market (e.g. home loan).
- Tightened carbon emissions standards on new build. Part L in the Isle of Man were raised in 2018 (DEFA Building Control - Part L Energy Efficiency Standards). Manx SAP rating to be introduced on 1st January 2020 with new buildings to be “Carbon Neutral” within 10 years, with regular tightening of standards.
- Carbon emissions standard on heating system replacement. This is a minimum standard on new heating systems based on carbon dioxide emission performance. This would replace the current energy efficiency requirement on boilers with a requirement that the average lifetime carbon intensity of new heating systems is less than 180gCO<sub>2</sub>/kWh (subject to suitability requirements being met). It could be targeted at specific property



types. This is not active in the Isle of Man, but would conceivably be done given that the source of boilers and trades would be no different to the UK.

#### 4. THE ACTIONS

- 4.1. The 2013 CCC analysis suggests that to achieve uptake consistent with the “cost-effective” path the following actions would need to be considered alongside actions to improve energy efficiency of homes:
- Enhanced heat pump certification (requiring installer and consumer training) with sustained information campaigns would need to be implemented this decade.
  - Heat pump uptake in new homes would need to be stimulated through tightening new build carbon/energy standards.
  - The suitability of the housing stock could become a major barrier to mass-uptake of heat pumps. Therefore, measures to improve the energy efficiency of the housing stock may be needed beyond 2030, particularly in “harder-to-treat” homes, for example the 20% of homes that are solid walled.
  - To reduce financial barriers and consumer hurdle rates, the Green Deal or a similar loan guarantee arrangement for heat pumps should be made available.
- 4.2. Performance: Poor performance of heat pumps is both a real barrier and an issue of consumer perception. Phase 1 of the UK Energy Saving Trust heat pump field trials, undertaken between April 2009 and April 2010, identified significant under-performance in terms of system efficiencies. Average results were disappointing across both air source and ground source installations, but particularly in the case of air source. The root cause of this was the experience and technical skills of the heating engineers involved.
- 4.3. Awareness and consumer acceptance: A lack of awareness of heat pump technology, particularly among domestic consumers, is a key barrier to uptake. When asked to describe their state of knowledge of a range of heating appliances, 68% of the householders surveyed stated that they had never heard of air source heat pumps and only 12% said they had heard of them and understand what they are. After being provided with information and asked how they feel about different heating appliance options, 40% said they felt very or fairly negative about air source heat pumps, compared to 29% that felt positively. The reasons given for attitudes toward air source systems included concerns about noise, the visual appearance of the external unit, concerns about vulnerability of the external unit to tampering and scepticism that the system would provide sufficient heat on cold days.
- 4.4. Breakdown or loss of performance of existing systems is by far the most likely trigger for investing in a new heating appliance. The distressed nature of purchasing boilers/heating systems compounds the lack of awareness of heat pumps, hence

reason for very low level of uptake. The survey found that when replacing a heating system, more than 40% of householders sought advice from the service engineer. For heat pump uptake to become more widespread, it will be important to ensure that the existing network of heating engineers provides advice about heat pumps and offers products and that their training and level of expertise meets the heat pump suppliers requirements.

- 4.5. Planning and Noise: Noise from the external fan and compressor unit of an air source heat pump is a potential source of nuisance both for the occupants of the building served by the heat pump and for their neighbours. Noise levels have been recognised as a potential consumer acceptance issue and a limiting factor on suitability of air source heat pumps in some areas (e.g. dense urban settings and Planning Conservation Areas in towns and villages).
- 4.6. In an effort to facilitate the uptake of heat pumps, alongside other renewable energy technologies, air source heat pumps have been included under permitted development rights in England. Subject to certain criteria being met, it is not necessary to obtain planning permission for the installation of an air source heat pump. It is notable that ASHP have also recently become a technology that also benefits from Permitted Development Rights in the Isle of Man, which took place in 2019. However this would not apply to properties in Conservation Areas. Manufacturers are also acutely aware of noise issues relating to the external unit. Recent development by Mitsubishi and their compressors and heat pumps has markedly reduced sound levels of units in operation to now being less than 45dB within one metre. Note noise measurements are on a log scale, so 3dB represents a doubling of sound level. An ambulance registers 120 dB(A) whereas a vacuum cleaner registers around 73 dB(A) and typical room conversation comes in at around 60 dB(A).
- 4.7. Innovations in fan and compressor design have enabled the heat pump units to achieve significantly lower sound levels. For example two models from one supplier are A++ ErP rated (which is a very high energy efficiency rating) and also available with coastal protection for areas where they can be exposed to saline. The Isle of Man is classed as a severe exposure zone due to wind, salt spray and rain events.

Our market leading Ecodan air source heat pumps are designed to provide a home with reliable, trouble free renewable heating and hot water.

**The New Ultra Quiet Ecodan takes air source heat pumps to the next level**

These new models offer superb style, market leading energy efficiency and sound levels. Designed especially for residential applications the 8.5kW and 11.2kW units are **3 times quieter than previous models, virtually eliminating planning restrictions.**

Typical sound pressure levels:

	120dB(A)		80dB(A)		60dB(A)		40dB(A)
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This means the Ultra Quiet Ecodan has a sound pressure level similar to a **Library**.

**8 dB(A) drop in sound power output**

Ultraquiet Ecodan by Mitsubishi Electric. (2019). *Ultraquiet Ecodan by Mitsubishi Electric*. [online] Available at: <https://ultraquietecodan.co.uk/> [Accessed 17 Dec. 2019].

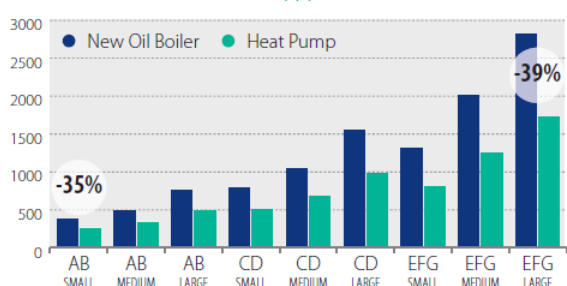
- 4.8. Suitability: The suitability of ground and air source heat pumps varies significantly across all property types, particularly in relation to how well-insulated the property is and the space available to fit the heat-pump based heating systems. The compatibility of low flow temperatures produced by heat pumps is important to be mindful of. The requirement to replace emitters, such as installing low temperature radiators (or under floor systems) and hot-water tanks can be a significant additional cost and also carries a large 'hassle factor' for consumers.
- 4.9. Costs and economics: Installation costs remain a significant barrier to uptake of both ground source and air source heating systems, as capital costs are substantially higher than those of incumbent systems, such as gas and oil boilers. The potential for installed costs of air source and ground source units to decrease over time has been explored through the consultation. The major components of heat pump systems, such as the compressors, are common to those used in air-conditioning units and are manufactured in vast numbers. No significant economies of scale are

therefore expected to result from growth of the heat pump industry. Capital cost reduction of around 10% by 2030 had been projected in the 2013 CCC report. The Manx Utilities Authority recently tabled a comprehensive report to Tynwald in February 2019 (GD No. 2019/0003) titled “home generation feed-in tariffs, electric vehicles and electric heating for buildings”. Within this report are some very relevant Appendices. For example Appendix C compares the marginal cost of a “generic ASHP” being £3k (with net CAPEX being £5k ASHP unit cost minus £2k Gas/Oil Boiler replacement cost) (see pages 25-26 of <http://www.tynwald.org.im/business/opqp/sittings/20182021/2019-GD-0003.pdf>)

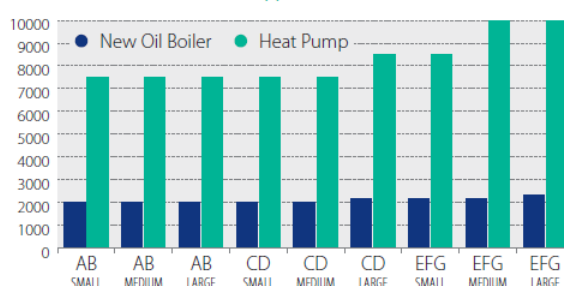
- 4.10. The ASHP costs could be significantly higher in reality, for example if a new hot water tank, larger radiators or larger flow pipes are required. It may also be appropriate to ensure the property is adequately insulated, which may also require investment.
- 4.11. Cost assumptions for heat pumps and hybrid heat pumps from UK CCC research suggests ASHP CAPEX by 2025 would be ~£4400, and annual maintenance costs of ~£100. This excludes any changes to radiators etc.
- 4.12. ASHP assumed to have lifespan of 18 years, GSHP 20 years. Also CCC assumed CoP (Co-efficient of Performance) improves from 2.5 to 3.0 by 2030.
- 4.13. In the scenario of there being ~20,000 homes with oil boilers and a life span of a boiler being 10-15 years around 2,000 oil boilers are replaced/installed each year. It is notable that unlike the UK and Ireland (and other European countries) an evaluation of a properties Energy rating e.g. Energy Performance Certificate does not apply to homes on the Isle of Man. Older properties would tend to have a poorer energy rating,

Sustainable Energy Association of Ireland: Replacing oil boilers with air-source heat pumps: household economics and system-wide impacts

ANNUAL HEATING BILL PER DWELLING (€) (BASED ON AVERAGE 2014 FUEL PRICES)



INSTALLATION COST PER DWELLING (€)



Air-Source Heat Pump Simple Payback (years)

Energy Rating	Simple Payback (years)
AB SMALL	41.6
AB MEDIUM	33.2
AB LARGE	19.8
CD SMALL	19.6
CD MEDIUM	14.9
CD LARGE	11.0
EFG SMALL	12.5
EFG MEDIUM	10.2
EFG LARGE	7.0

Source being Irish [www.seai.ie](http://www.seai.ie)

4.14. Manx Utilities are part way through an Air Source Heat Pump trial covering a range of house types and ages to reflect the Isle of Man context, aiming for ~50 houses to be included, as at October 2019:

- Around 12 heat pumps have been or are close to being installed so far.
- Main issue for a few potential heat pump enquiries has been the need for some upfront investment in thermal insulation and/or radiators to ensure effective comfort temperatures can be achieved with a heat pump – and leading to a smaller capacity heat pump and consequently reduced running costs for the homeowner. As the leasing scheme does not cover thermal efficiency measures or radiators, prospective heat pump owners have been asked to fund this investment themselves which in some cases has been a financial constraint. Suggest that Govt steps in to provide some grant support for thermal insulation –or could the Green Loan scheme be used to fund both thermal insulation and new radiators?
- There are another 20-30 interested heat pump customers on the Manx Utilities Authority ‘reserve’ list – and others being constantly added on a weekly basis;
- For a few heat pump clients, the initial quotation has been significantly higher than envisaged and clients have decided on a more conventional heating solution;
- Some houses have been (heat assessment) surveyed and found not suitable for heat pump operation while others have required ‘doubling’ of large HPs resulting in relatively expensive outlays which were considered too expensive for the heat pump trial;
- Bivalent heat pump schemes may be recommended as a ‘cheaper’ alternative for some larger properties due to the initial capex and opex for a pure heat pump arrangement - but the hybrid arrangement will not be funded by the current MUA trial leasing scheme.

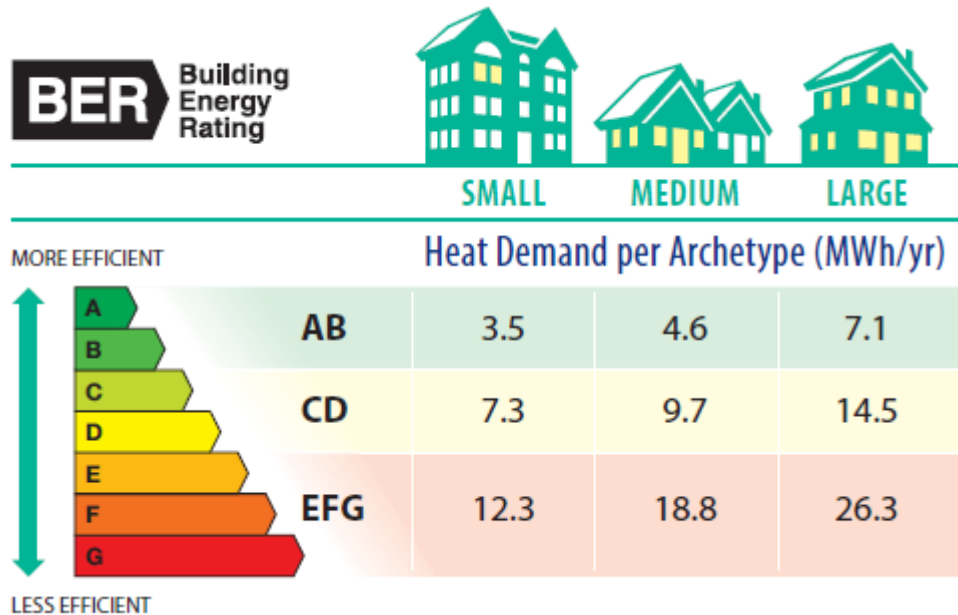
4.15. Manxifying the UK conversion costs for 22 million heat pumps by 2050 alongside grid reinforcement costs and the mass roll out of EV charging points figures for the Isle of Man, it is estimated that c£300 million would be required to convert all households (equating to ~£7k per household) on the Island to heat pumps and £88 million for public electric vehicle (EV) charge points. However the latter would be dependent on the ratio of public EV CPs/EVs (if we target 1:10, then the costs would be lower), charging rate of CPs, Vehicle to Grid (VtG) technology advances, autonomous vehicles, smart charging, car sharing etc. The total heat pump investment cost could be mitigated with decarbonised heating also supplied by localised district heating schemes using ‘green gas’ fired combined heat and power units (CHPs), heat recovery using heat pumps from Manx Utilities water treatment and sewerage treatment works, heat recovery mechanisms associated with the Combined Cycle Gas

Turbine (CCGT) and Energy from Waste (EfW) plant in the short to medium term, biomass/CHP fuelled community energy hubs, etc.

- 4.16. There are a range of Air Source Heat Pump (ASHP) suppliers; however, the fundamental components are the compressor and common refrigeration technologies.
- 4.17. There have also been trials undertaken to upgrade existing public sector properties to meet a future net zero emission scenario. A relevant project has been Energie Sprong [Energiesprong.org](https://energiesprong.org/). (2019). (Available at: <https://energiesprong.org/>) derived from a Dutch social housing project, but also picked up in the UK to trial. In essence the concept is to over clad an existing property, make it super energy efficient, non-draughty, and low energy costs for the tenant. The unit would have PV panels on the roof, and whole house Mechanical Ventilation Heat Recovery (MVHR) to ensure adequate ventilation. Guarantees for tenants are that the household temperature would be no less than 21C all year round, 140 litres of hot water per person per day, and 2000kWh of electricity provided by roof mounted PV panels.
- 4.18. All this would be guaranteed for a rent per week no more than is currently provided to their local authority landlord. This may be of interest to the Isle of Man given there are >7000 units of social housing, some of which very dated and overdue refurbishment. Points system operates on the Isle of Man for rental settings with an air source heat pump resulting in 5 additional points. Approximately thirty heat pumps installed at Ayre View (a Public Sector housing estate in Bride village, and another 16 planned in Ramsey. The additional approximately £300/annum increase in rental is outweighed by the circa £500 saving per annum in utility costs for the householders. Due to the scale of deployment at Ayre View, combined with the fabric improvement of the properties the capital costs per property for insulation improvements and supply and install of air source heat pumps was less than £10k per property. This demonstrates the merit of utilising Framework Agreements where scale can be indicated.

5. THE IMPACTS AND MITIGATIONS FOR THEM

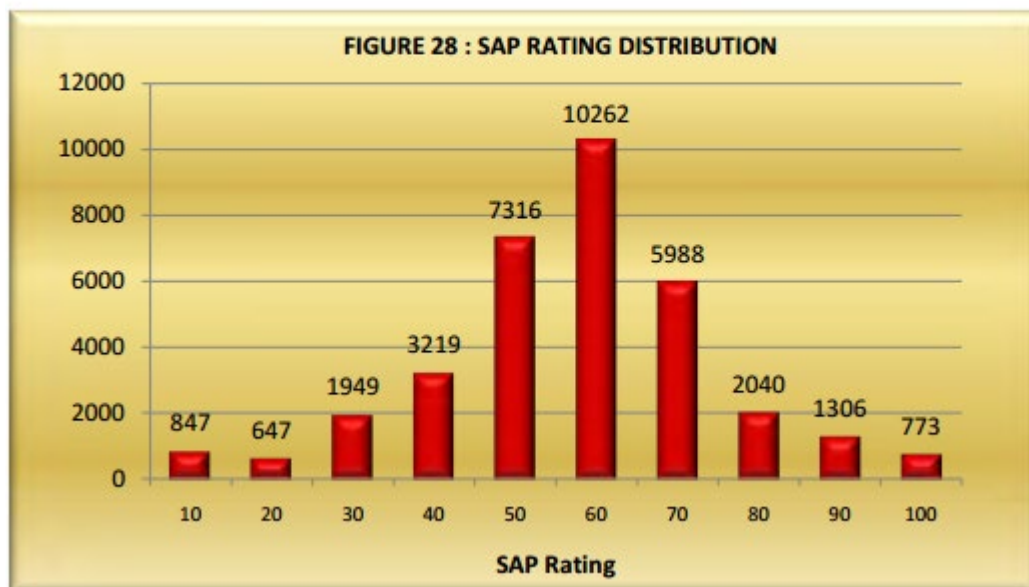
Sustainable Energy Association of Ireland: Replacing oil boilers with air-source heat pumps: household economics and system-wide impacts



Source being [Sustainable Energy Authority of Ireland www.seai.ie](http://www.seai.ie)

5.1. The above image is illustrative of the domestic energy demand (heating and hot water) compared to property size (flat, to medium sized to large) rated according to the Building Energy Rating (BER) and their respective energy needs based on their Energy Rating in range A-G, with G being the least energy efficient, based on a study from Ireland. The UK equivalent to this would be Energy Performance Certificate (EPC), which also has categories A-G. Although the Isle of Man does not currently have a requirement for EPC, the SAP (Standard Assessment Protocol) surveys required for the Private Sector House Condition Survey assesses some the metrics that the EPC would require. As can be seen below the average would be EPC Band E and a long way from average of SAP 70 or EPC C rating which had been the Isle of Man target to aim for an average EPC rating by 2050.

The current SAP rating for private housing on the Island is measured at 53, above the national average for all private housing in England (47). The equivalent NHER Rating is 8.7.



[https://www.gov.im/media/208720/private\\_sector\\_house\\_survey.pdf](https://www.gov.im/media/208720/private_sector_house_survey.pdf) Page 46

## 6. THE COSTS AND RETURNS

6.1. Key barriers to achieving the required level of uptake include cost, awareness, confidence, suitability and installer capacity. These are the issues identified in the UK CCC Report in 2013, and would equally apply to the Isle of Man.

### Image of Categorisation of policy measure to encourage heat pump uptake



Source: Frontier Economics

### Page 90 of UK Committee on Climate Change (CCC), October 2013.

Ireland, as a peer jurisdiction with a comparable housing stock judged that the most appropriate means to upgrade the cohort of properties in BER/EPC category of E/F/G was to facilitate a substantial grant and loan package through their “Deep Refurb” scheme in order for the home to reach A rating and therefore suitable to heat pumps etc. This grant scheme offered up to Euro100,000 per property, so a very sizable cost when deployed at scale. It is noted this scheme closed ahead of schedule in September 2019. This was not regarded as a cost-efficient scheme, and no alternatives have been proposed to replace it.



## 7. THE RISKS

- 7.1. There are a wide range of policy measures that could be used to address the barriers shown above. These range from “enabling” measures (which tackle behavioural barriers to uptake such as awareness and confidence) “incentivising” measures (which provide financial inducement to the take-up of heat pumps or related infrastructure such as energy efficiency) and “mandating” measures (which make regulatory requirements on heat pump uptake or carbon performance of heating systems).
- 7.2. It is noted the UK has not been able to meet the required uptake rate of Heat Pumps, and there is no reason to conclude the Isle of Man would be any different to this, unless measures are put in place. Note that the UK are planning for a range of heating technologies to be deployed over the next few decades including hybrids gas boiler/HPs, micro CHPs, Biomass, District heating and bio-LPG. This is the reason why the following paragraphs are noted – the risks of not meeting an adoption schedule at pace would be high, if adequate enabling measures, incentivising measures and regulatory measures were not in place and operational.
- 7.3. Enabling measures: Enhanced heat pump certification (requiring installer and consumer training) with sustained information campaigns.
  - a standard requirement for all heating system installers to be given basic training (in addition to existing Microgeneration Certification Scheme (MCS) requirements for training for installers of heat pumps) This must include a means to assess heat loss of a property, and types of heat emitters (eg underfloor heating, oversized radiators etc). Of equal importance for customers will be identifying where a property is unsuitable for an Air Source Heat Pump.
  - a standard requirement that installers train consumers in using their heat pump efficiently (via a requirement that installers deliver a standard level of training and performance monitoring).
  - marketing/information campaigns on the benefits of, and process for, installing heat pumps. Some countries there are special (preferential) tariffs for customers who use heat pumps.
- 7.4. These measures are aimed at reducing the behavioural barriers to heat pump uptake. In particular, improving awareness and confidence in the technology, reducing hidden costs and improving the operational performance of heat pumps. There is evidence that these schemes have been effective in other countries. Moreover the costs of this bundle could be relatively low. The estimated additional costs of around £60/installation for his measure.
- 7.5. Incentivising measures: Extension of the Renewable Heat Incentive (RHI) operating subsidy beyond 2020 (for all renewable heat technologies). The RHI is not available in the Isle of Man. The RHI is a subsidy paid for each kWh of renewable heat

produced based on deemed heat usage. In the Domestic sector, UK RHI for ASHP is paid at a rate of 7.3p/kWh. Recently increased to 10p/kWh but capped at 20,000 kWh (green units) and valid for 7 years. Additional support given to heat meters to monitor output. This again reflects low UK gas prices of approximately 4p/kWh. It directly addresses the costs barrier and, to the extent it stimulates mass uptake, the awareness and confidence barrier could be reduced.

- 7.6. In the UK situation, while the RHI could be very effective in tackling cost barriers and encouraging uptake it also implies high costs to government which in turn can create some uncertainty for consumers and the heat pump industry over future tariff levels and funding availability. In the UK this uncertainly and stop-start nature of funding schemes had a serious adverse effect on consumer and business confidence.
- 7.7. Capital grants. This is a one-off upfront payment to consumers to offset the capital cost of heat pumps. As an upfront subsidy it addresses both the cost and access to finance barriers to uptake. From a government perspective a drawback of the policy is that subsidy payments must be frontloaded. However, at the same time this may improve consumer confidence as they are not dependent on future subsidy payments as is the case under the RHI. We note that in other European countries to date, capital subsidies have been more commonly used than RHI-style operating subsidies. It is also notable that subsidies arising from the Renewable Heat Premium Payment Scheme (RHPP) and those arising under energy supplier obligations (CERT (Carbon Emission Reporting Target), CESP (Community Energy Saving Programme) and now ECO) (Energy Company Obligation) manifest themselves as upfront capital subsidies.
- 7.8. Loan guarantees and social finance. The Green Deal provided loans for energy efficiency and low-carbon measures (including heat pumps) to be secured against the consumers' property and repaid through the energy bills of the property. In this way, the Green Deal helps to overcome the financing barrier to heat pumps uptake. The Green Deal may also help focus heat pump installations in homes where they are most cost-effective. In order to receive a Green Deal loan an assessment must be undertaken to ensure measures are cost-effective. Homes with high suitability, where refurbishment costs are low, are more likely to be recommended heat pumps under these assessments.
- 7.9. In the base case it had been assumed the Green Deal would continue in place to 2020, and then on to 2030 and is available for heat pumps. A 7% interest rate for Green Deal loans is the rate assumed.
- 7.10. The CCC heat pump report also considered an idealised form of 'social finance' where consumers are able to access loans at the social discount rate (3.5%) and always invest if the return on investment exceeds this. The Isle of Man does not currently have a Social Discount Rate, although plausibly one could be established via the likes of Manx Credit Union. A lower cost way to access the funding may be via equity release if property owner has equity in the property, in which case loan charges may be at a mortgage rate, which may be a lower cost way to access the capital for the work requested.

- 7.11. Mandating measures: Tightened carbon emissions standards on new build. This policy measure would first reduce the carbon standard in Part L of the Building Regulations. There is scope to do so on the Isle of Man, as Building Regulations are set and controlled by Tynwald. This tightening of carbon standards in buildings would have the advantage of allowing housebuilders to have flexibility to choose the most cost-effective solutions to meet the low carbon standards.
- 7.12. Carbon emissions standard on heating system replacement. This is a minimum standard on new heating systems based on CO<sub>2</sub> performance, subject to suitability requirements for alternatives to the existing system being met. In effect, this rules out gas condensing boilers as an option for heating systems and makes heat pumps the most cost-effective option in many cases. In our policy packages, this policy is sometimes applied to specific property types (e.g. off-gas grid) and phased in at different times. The policy has the advantage of limited direct cost to government (which may make it more robust to change). However, consumers will face higher heating system replacement costs which could be a major issue for lower income households with limited access to finance (in particular given that many purchases will be unplanned, distressed purchases).
- 7.13. The policy has the advantage of limited direct cost to government (which may make it more robust to change). However, consumers will face higher heating system replacement costs which could be a major issue for lower income households with limited access to finance (in particular given that many purchases will be unplanned, distressed purchases). Other option is a third party – Energy Service Company (ESCO) – providing heating as a service where outcomes are measured on a desired room temperature ie 21 deg C living rooms guaranteed. Subscription service whose level dependent on final temp required in each of the rooms in your house.

## **8. THE CO-BENEFITS (THE POSITIVE BENEFITS ASSOCIATED WITH THE CLIMATE ACTION)**

- 8.1. In aggregate would be warmer, carbon neutral homes, with low running costs:
- Local resilience – buildings, heating and power
  - Wider sustainability benefits e.g. reduced impact from flooding, recycling, waste management, reduced water consumption/better management
  - Reduction in fuel poverty
  - Could stimulate local economy
  - Reducing cold related illness
  - Strengthen Energy security

## 9. CONCLUSION

- 9.1. It remains appropriate to refer to the UK's CCC analysis of the emerging sector of Heat Pumps as an option for heating of homes and their lessons learned. Based on this comprehensive research and analysis, the take home messages and concluding remarks would therefore be:
- Enhanced heat pump training for installers and consumers with sustained information campaigns would need to be implemented soon, which would need to be relevant to installers and householders with bespoke communications to each respective audience.
  - Heat pump uptake in new homes would need to be stimulated through tightening new build carbon/energy standards.
  - The suitability of the housing stock could become a major barrier to mass-uptake of heat pumps. Therefore, measures to improve the energy efficiency of the housing stock may be needed beyond 2030, particularly in "harder-to-treat" homes, for example the 20% of the Isle of Man homes that are solid walled, which was also the finding of the MUA trial.
  - To reduce financial barriers and consumer hurdle rates, an Isle of Man equivalent to the Green Deal or a similar loan guarantee arrangement for heat pumps (and energy efficiency upgrade of the property) should be developed and made available.
- 9.2. It would also be appropriate to further investigate whether a Manx version of Energie Sprong would be appropriate as a means to upgrade social housing at scale.
- 9.3. There may also be scope to develop a Framework Agreement route to procure Air Source Heat Pumps, leveraging economies of scale for Public Sector Housing as was developed for the Ayre View trial.

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