Department of Energy & Climate Change

Metering for Payment Technical Supplement

Outline of Metering for Payment requirements for the domestic Renewable Heat Incentive

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https://www.gov.uk/government/consultations/renewable-heat-incentive-proposals-for-a-domestic-scheme

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Introduction

This document sets out technical details for Metering for Payment in the domestic Renewable Heat Incentive (RHI) policy. The final requirements will be set out in the regulations implementing the scheme, which will be subject to the necessary approvals (including Parliamentary approval), and further detail will be provided in Microgeneration Certification Scheme (MCS) guidance as relevant. This document is intended to provide more information regarding our policy in order to assist those people choosing to install systems before the scheme launches. In addition to this guide, we are working closely with MCS and Ofgem to create further (more comprehensive) metering guidance for the domestic RHI before the scheme opens for payments. Once these documents are in service, they will supersede this document.

As discussed in the domestic RHI policy document[1], there are two circumstances where we expect to require meters to be installed as a basis for making payments in addition to the completion of a deeming calculation. In these cases, payment would be based on a metered renewable heat figure capped (annually) to the overall deemed renewable heat value. This is calculated from the heat demand on the Energy Performance Certificate and the design Seasonal Performance Factor (SPF, a measure of efficiency) from the Heat Emitter Guide in the case of heat pumps. The two situations are:

1. Where a heat pump or biomass boiler is installed alongside another fossil fuel system or renewable space heating system (this includes hybrid systems);
2. Where a heat pump or biomass boiler is being installed in a property that has been defined as a second home.

For such situations, the renewable heat from the heat pump or biomass unit must be measured. The number of meters required and complexity of metering vary from one heat meter to a combination of heat meters and electricity meters. This document provides information regarding the metering required and how renewable heat will be calculated from meter readings. Our intention is to require the simplest possible metering arrangements necessary for making payments.

[1] https://www.gov.uk/government/consultations/renewable-heat-incentive-proposals-for-a-domestic-scheme

Biomass metering concept

For biomass units, the EU Renewable Energy Directive (RED)[2] classifies all the heat output delivered from the biomass unit as renewable. Therefore, the total heat output from the system needs to be metered.

If the biomass unit is part of a hybrid system, for example, including a gas boiler, then energy produced solely by the fossil fuel boiler should be subtracted from the heat produced by the biomass boiler alone if required.

Heat pump metering concept

For heat pumps, the RED specifies renewable heat as the heat output from the heat pump minus the energy input to the heat pump that is not from a renewable source, e.g. electricity and/or gas input to the heat pump. This is as per the guidance in the RED for calculating renewable heat. We appreciate that many customers will have purchased electricity on green tariffs or may have generated the electricity using renewable sources, however, this will not impact upon the quantity of heat output considered to be renewable in this case.

The number and location of meters required for any specific heat pump will depend on what sort of system is being installed but the overall concept is:

Measure the total heat output from the renewable heating system's components, including whatever components are practical to measure, and measure the energy input to the same components.

Solar thermal metering concept

We will not require metering for payment for heat output from solar thermal systems. For these installations, the renewable heat output will be based on the deemed heat.

Section 1 illustrates these concepts using some worked examples of our metering location requirements for biomass and heat pump installations with the aid of simplified schematics. Sections 2 and 3 detail the requirements for the meters themselves and how we intend to calculate renewable heat from the metering.

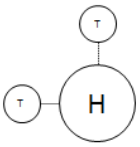
[2] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=Oj:L:2009:140:0016:0062:en:PDF

Contents

1. Placement of Meters

We present some case studies to illustrate our requirements for Metering for Payment in this section of the document. Larger full-page images of each figure are presented in Annex 1 at the end of this document.

In the following examples, we work through a number of simplified schematics to illustrate placement of meters/sensors. A key for the types of meters/sensors is shown below:



Heat meter, including flow meter (H part) and two temperature sensors

Temperature sensor

Electricity meter

Worked Example 1: A pellet biomass boiler providing space heating and domestic hot water in a second home

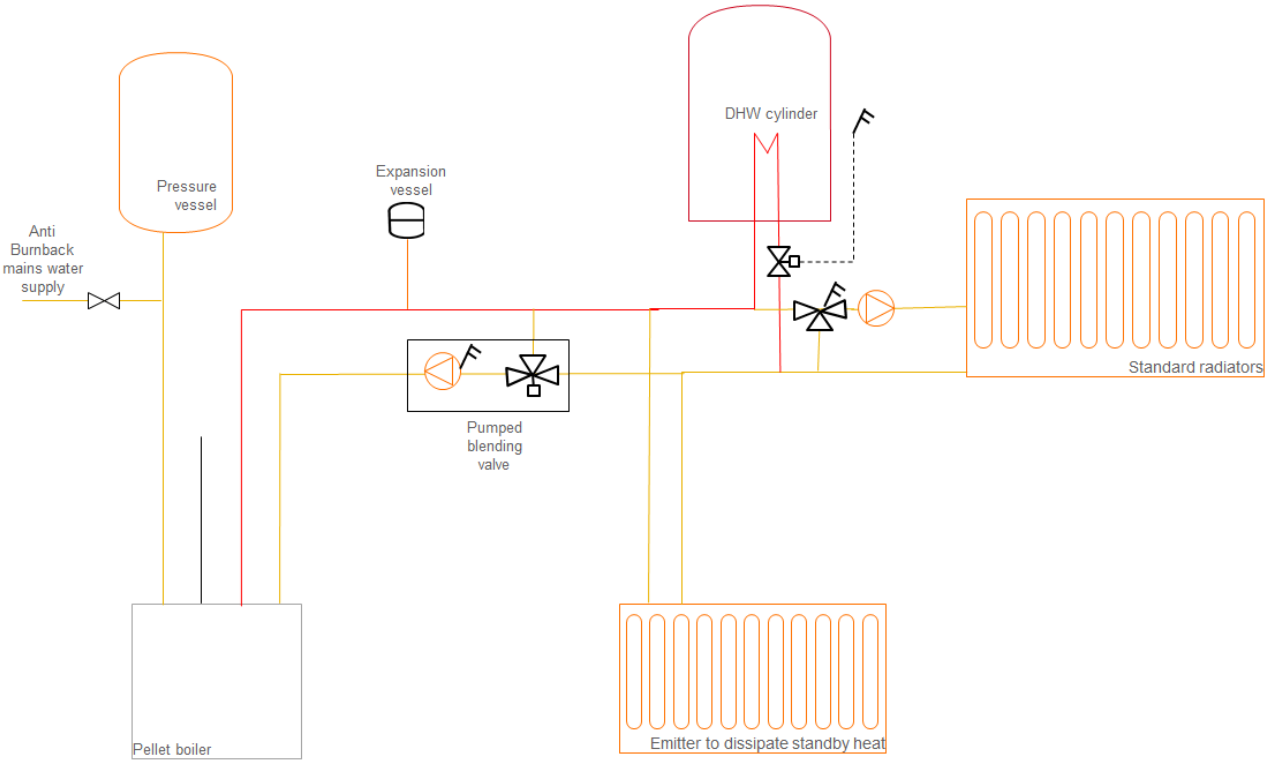


Figure 1: Pellet biomass boiler

For the simplified schematic shown in Figure 1, since the RED classifies all heat output from the biomass boiler as renewable and since the boiler is not a hybrid, inputs to the system do

not need to be measured and therefore the following metering (Figure 2) is one of the simplest approaches that can be taken and requires only a single heat meter:

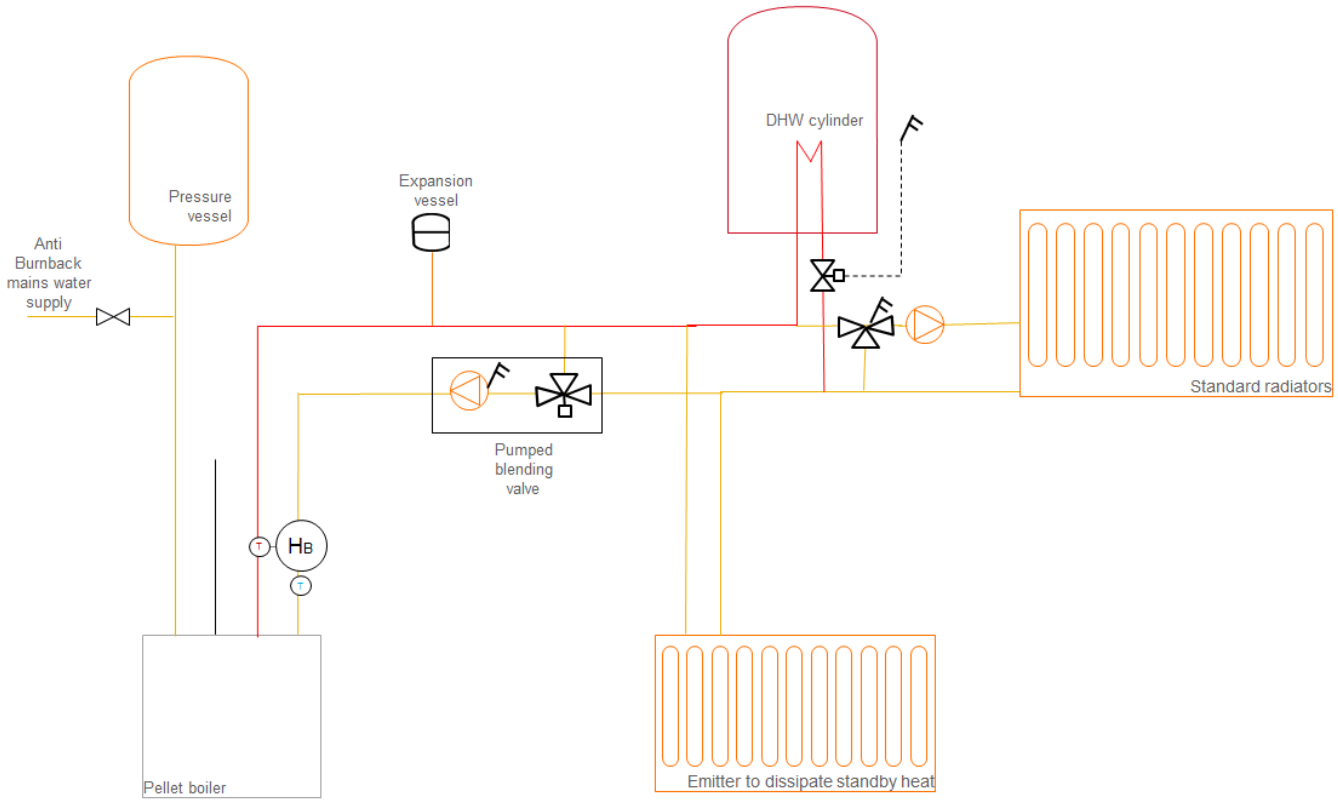


Figure 2: Pellet biomass boiler with metering option 1: 1 heat meter

Pellet stoves with back boilers are also eligible for the domestic RHI. For these systems, the heat-conveying liquid can be metered as in the above example and we will make an assumption for heat conveyed directly to the room as detailed in Section 3.

Worked Example 2: An air-source heat pump with a back-up fossil fuel boiler providing both space heating and domestic hot water

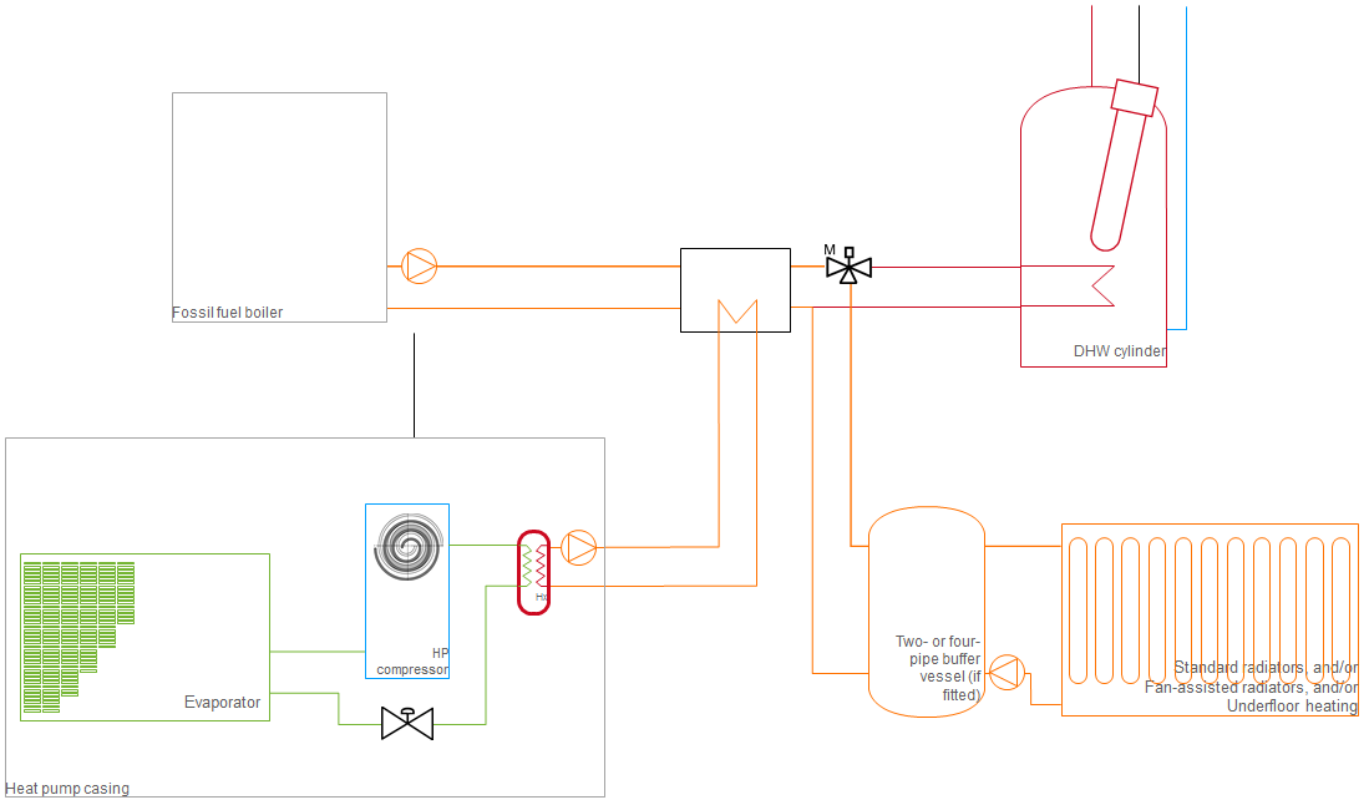


Figure 3: Air-source heat pump with back-up fossil fuel boiler

For heat pumps, our metering concept is that you:

> *Measure the total heat output from the renewable heating system's components, including whatever components are practical to measure, and measure the energy input to the same components.*

This potentially allows metering at a number of locations. One example of compliant metering would be metering of the electrical supply to the heat pump and metering heat on the heat pump distribution pipes as shown in Figure 4. This is compliant because where heat has been measured from components (i.e. the compressor, fan and circulation pump), the electrical supply to the same components has also been measured. The renewable heat here is then H_{hp} minus E_{hp}, i.e. the heat measured from the heat pump minus the electric power consumed by all of the components inside the heat pump.

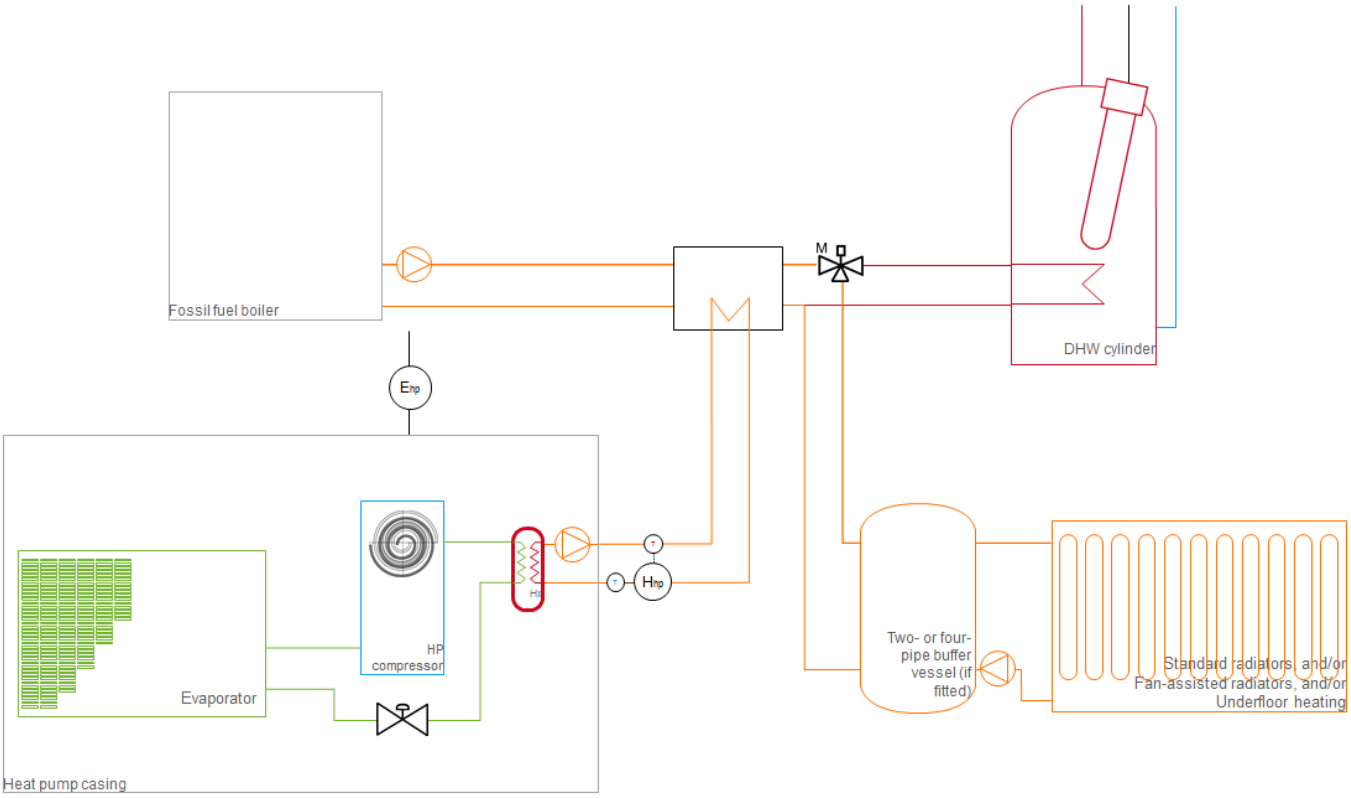


Figure 4: Air-source heat pump with back-up fossil fuel boiler showing metering option 1: 1 heat meter and 1 electricity meter

An alternative method of metering this system is shown in Figure 5 where a manufacturer has integrated the heat meter into their product:

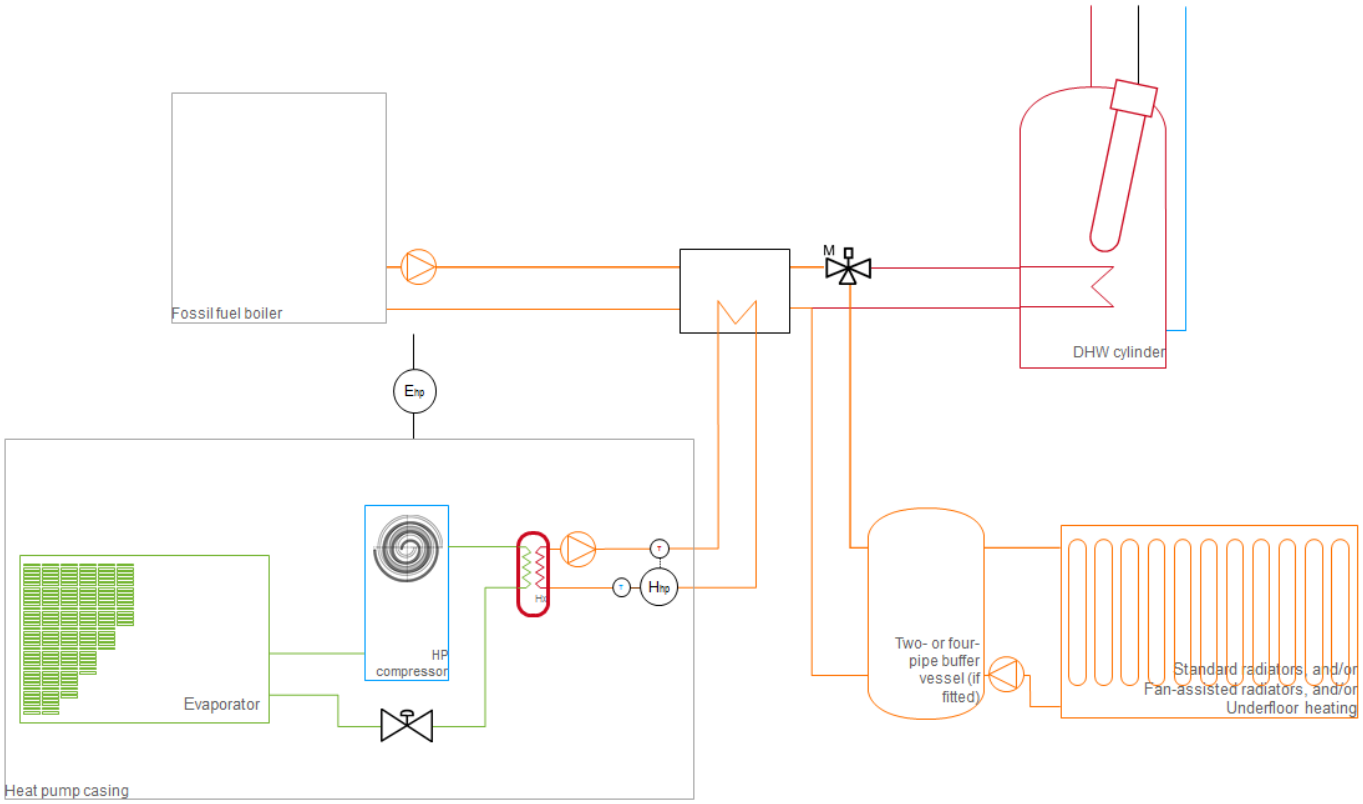


Figure 5: Air-source heat pump with back-up fossil fuel boiler showing metering option 2: 1 heat meter (integrated) and 1 electricity meter

Manufacturers integrating metering into their products can simplify metering arrangements and reduce the risk of meters being specified or installed incorrectly. We encourage manufacturers to do this, particularly in light of DECC's intention to consider requiring all systems to be metered after the scheme review in 2015.

In each of the examples, the electric power consumed by the circulation pump must be included in the electricity meter reading since the heat created by the circulation pump has been included in the heat measurement.

As discussed, heat output can be measured for any combination of components so long as energy input to those components is also measured. The flexibility of this approach means that a wide range of approaches to metering are possible to allow for a wide range of household plumbing scenarios.

Worked Example 3: A ground-source heat pump with integrated domestic hot water cylinder

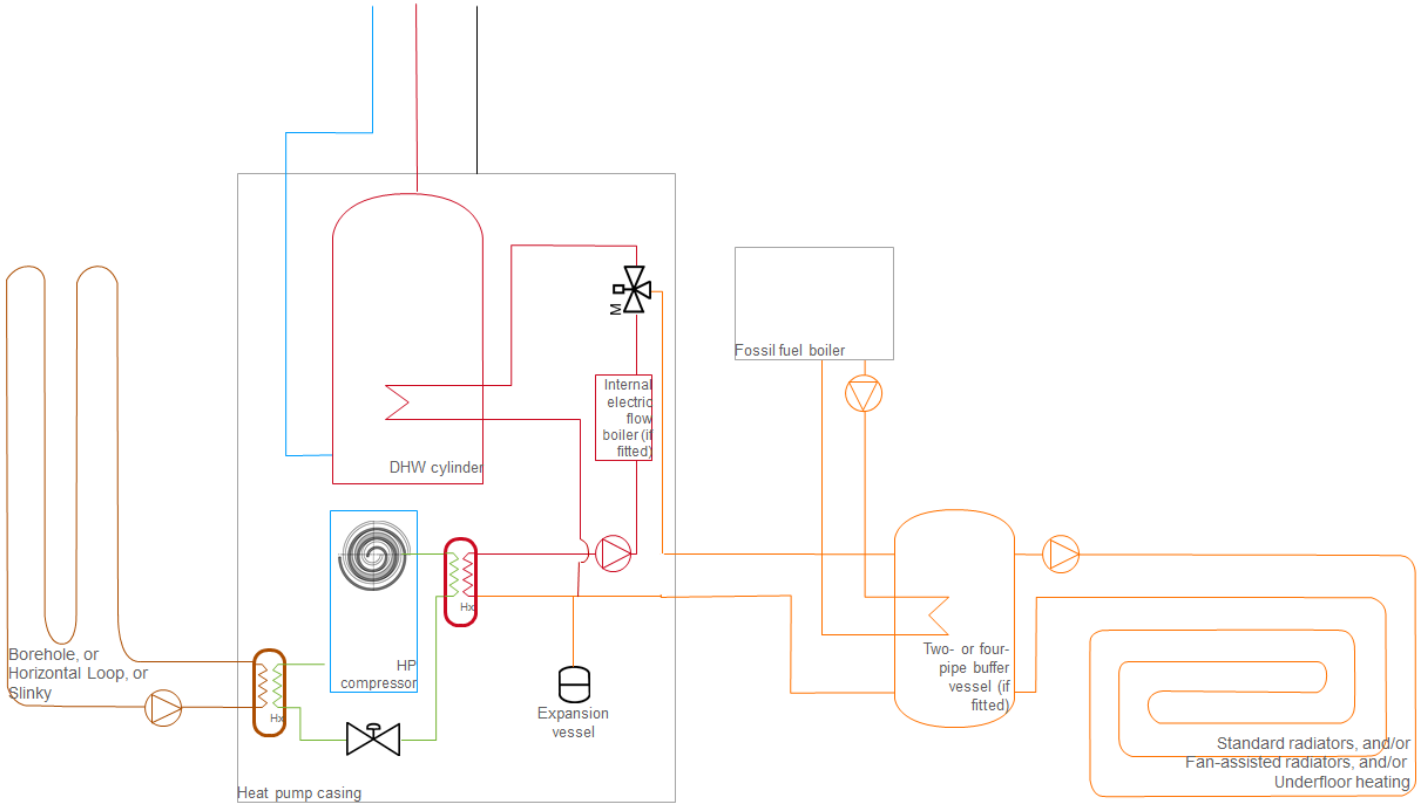


Figure 6: Ground-source heat pump with integrated domestic hot water cylinder

Considering our requirement to make sure that where heat output is measured from a component then energy input to the same components is also metered, the schematic in Figure 7 shows one possible approach to metering that would be compliant for the system in Figure 6.

The approach in Figure 7 requires us to make assumptions for losses from the domestic hot water cylinder in order for the metering to be comparable to that for Worked Example 2. Section 3 provides more detail on how we intend to calculate renewable heat in these scenarios.

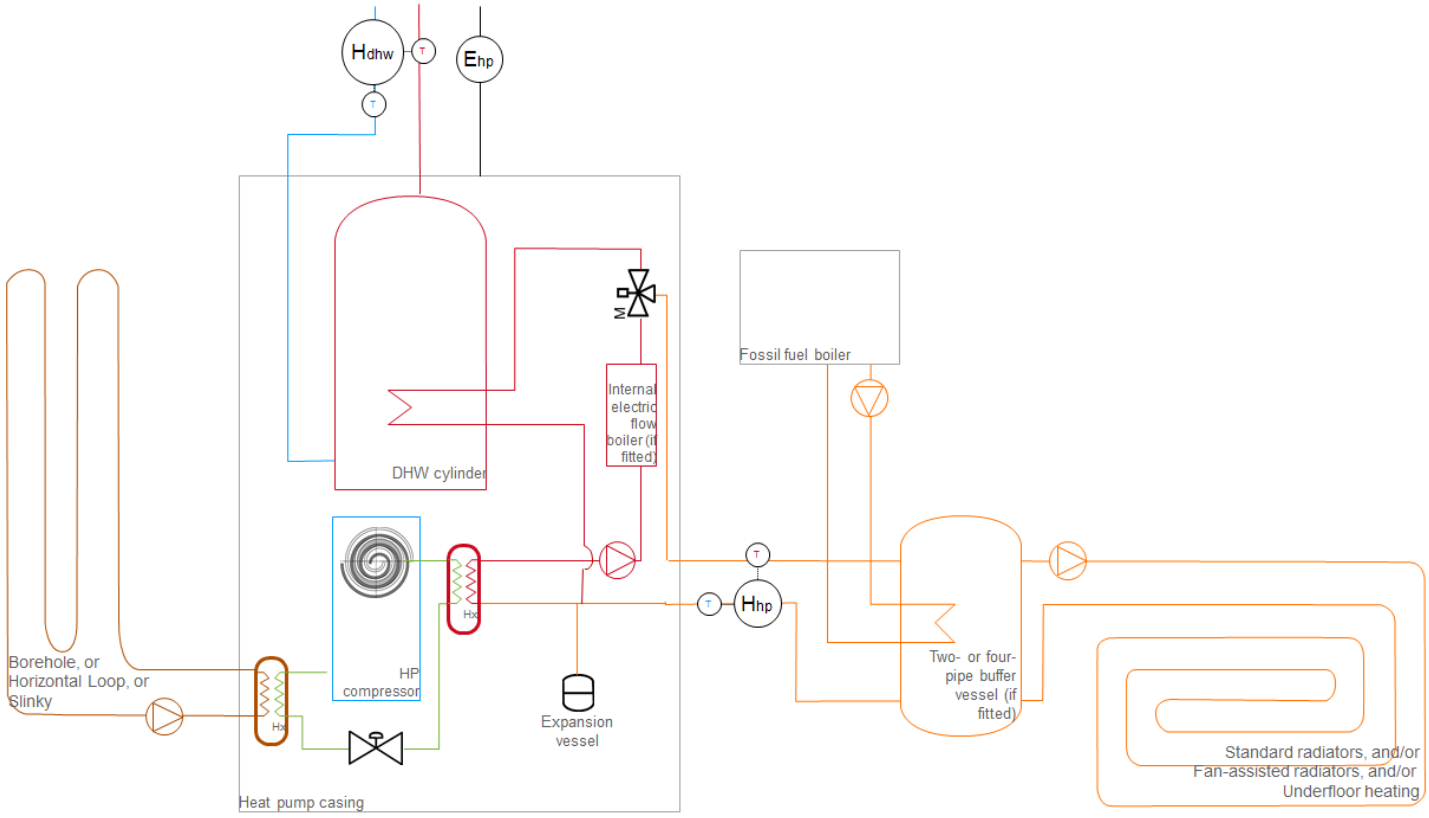


Figure 7: Ground-source heat pump with integrated domestic hot water cylinder and metering option 1: 2 heat meters, 1 electricity meter

If a manufacturer is able to integrate the metering then the metering arrangement in Figure 8 would also be possible, though it should be noted that in this case, the internal electric flow boiler should not be included in the electricity measurement since its output has not been included in the heat measurement. (Including the electric power consumed by the internal electric flow boiler without measuring heat output from it would penalise the RHI applicant in any case by lowering their overall renewable heat measurement).

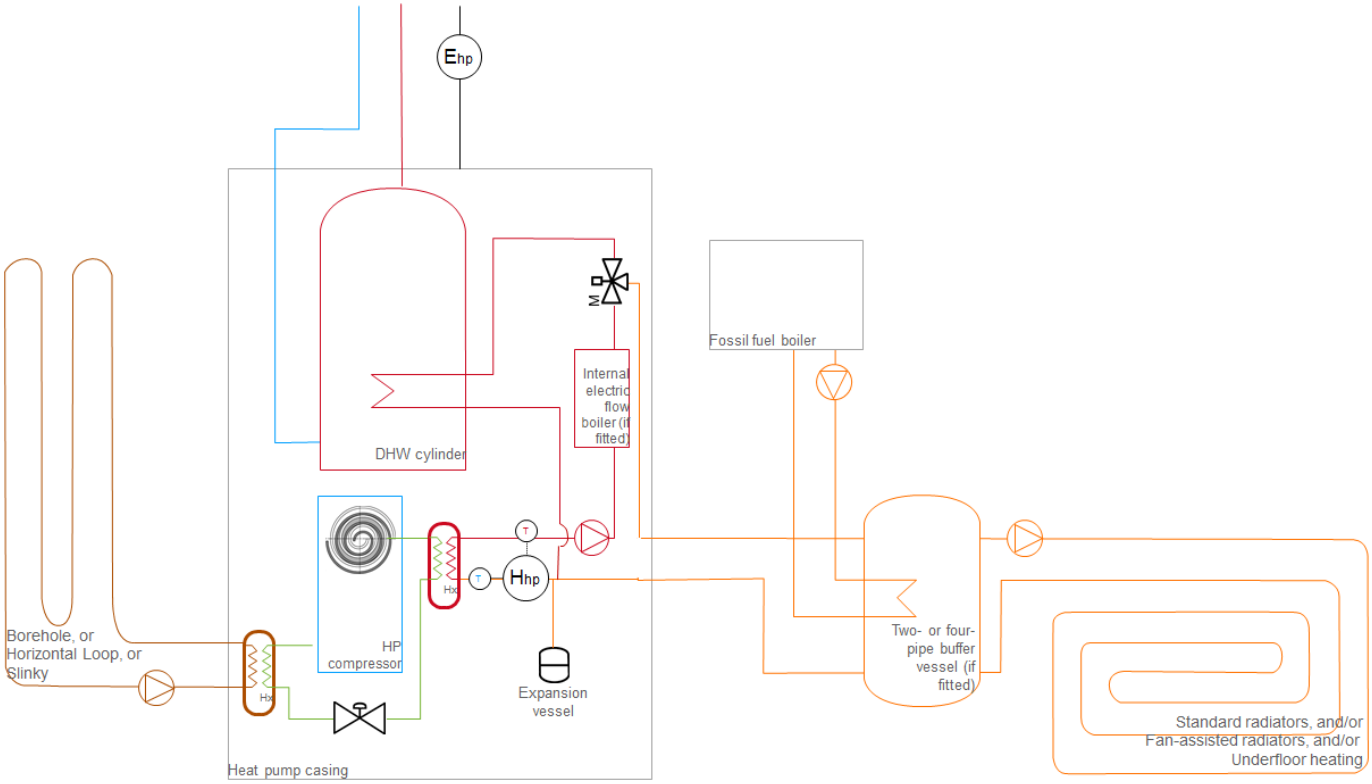


Figure 8: Ground-source heat pump with integrated domestic hot water cylinder and metering option 2: 1 heat meter (integrated), 1 electricity meter

Worked Example 4: A split-system air-source heat pump providing space heating and domestic hot water

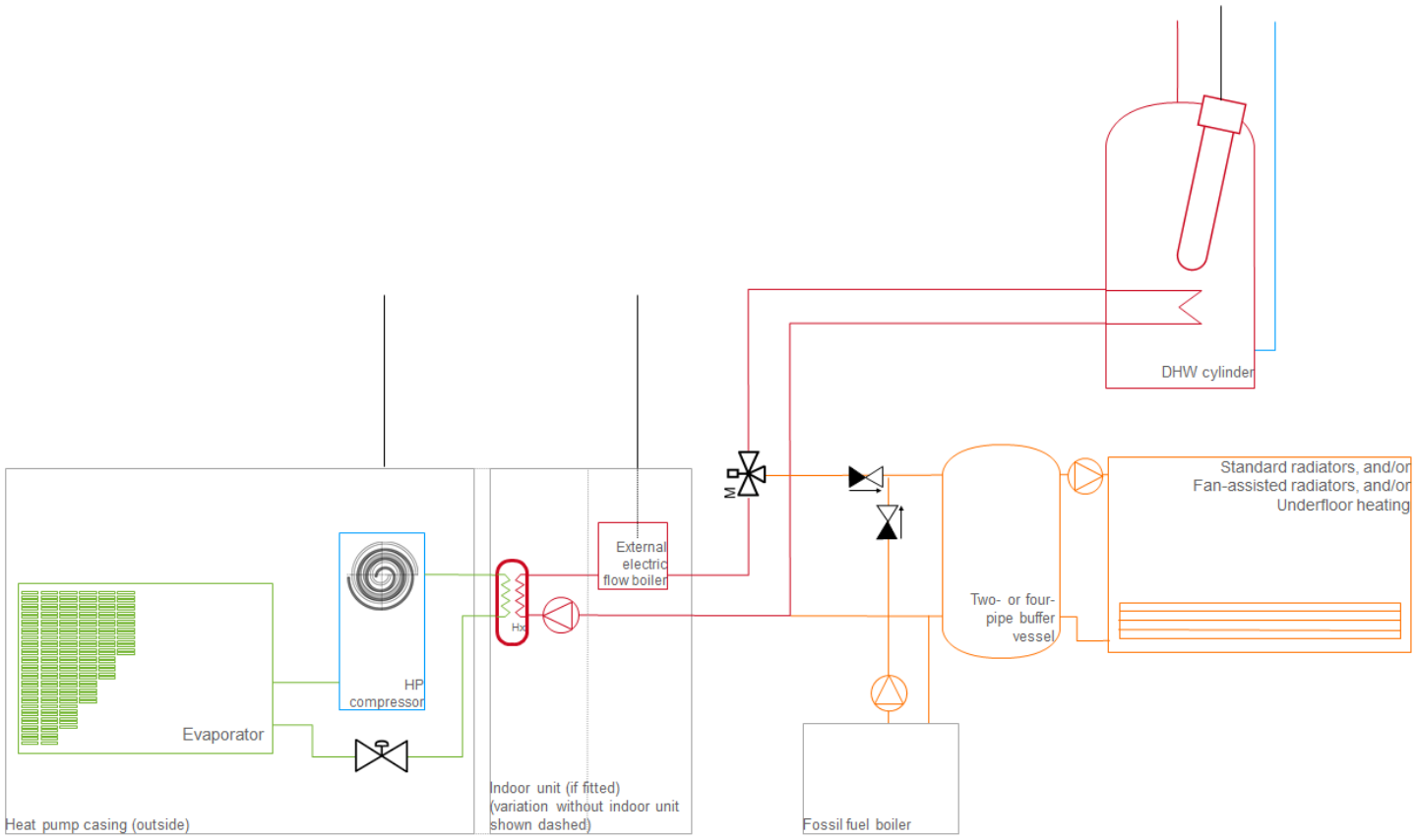


Figure 9: Split-system air-source heat pump providing space heating and hot water

The split-system air-source heat pump in Figure 9 can be measured in a number of ways. Firstly, the electrical supply to the two units could be measured separately (E_{hp} and E_b) as shown in Figure 10:

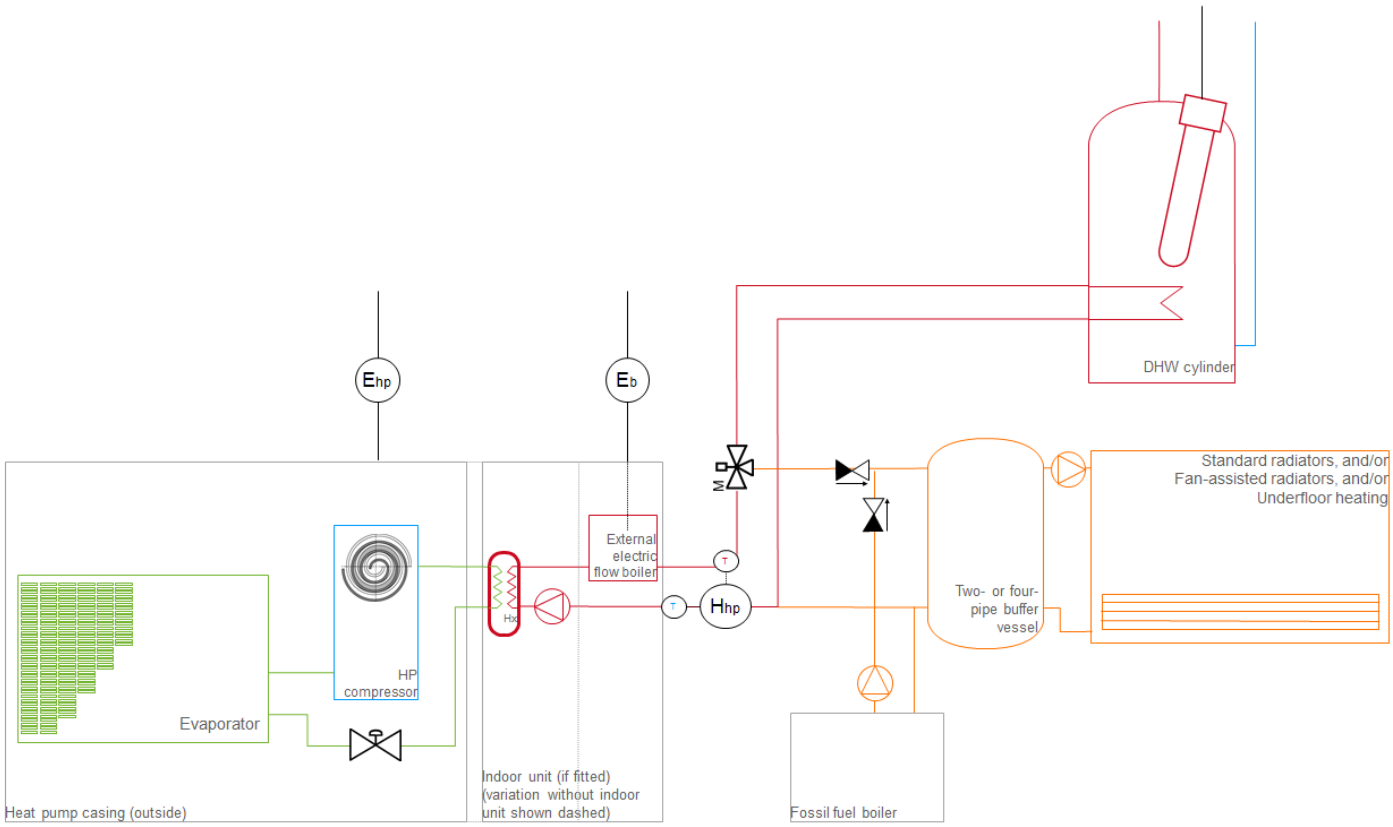


Figure 10: Split-system air-source heat pump with metering option 1: 1 heat meter, 2 electricity meters

Crucially, the heat measured by H_{hp} captures energy from both electrical supplies, meaning that electric power consumed by both the internal and external unit *must* be measured.

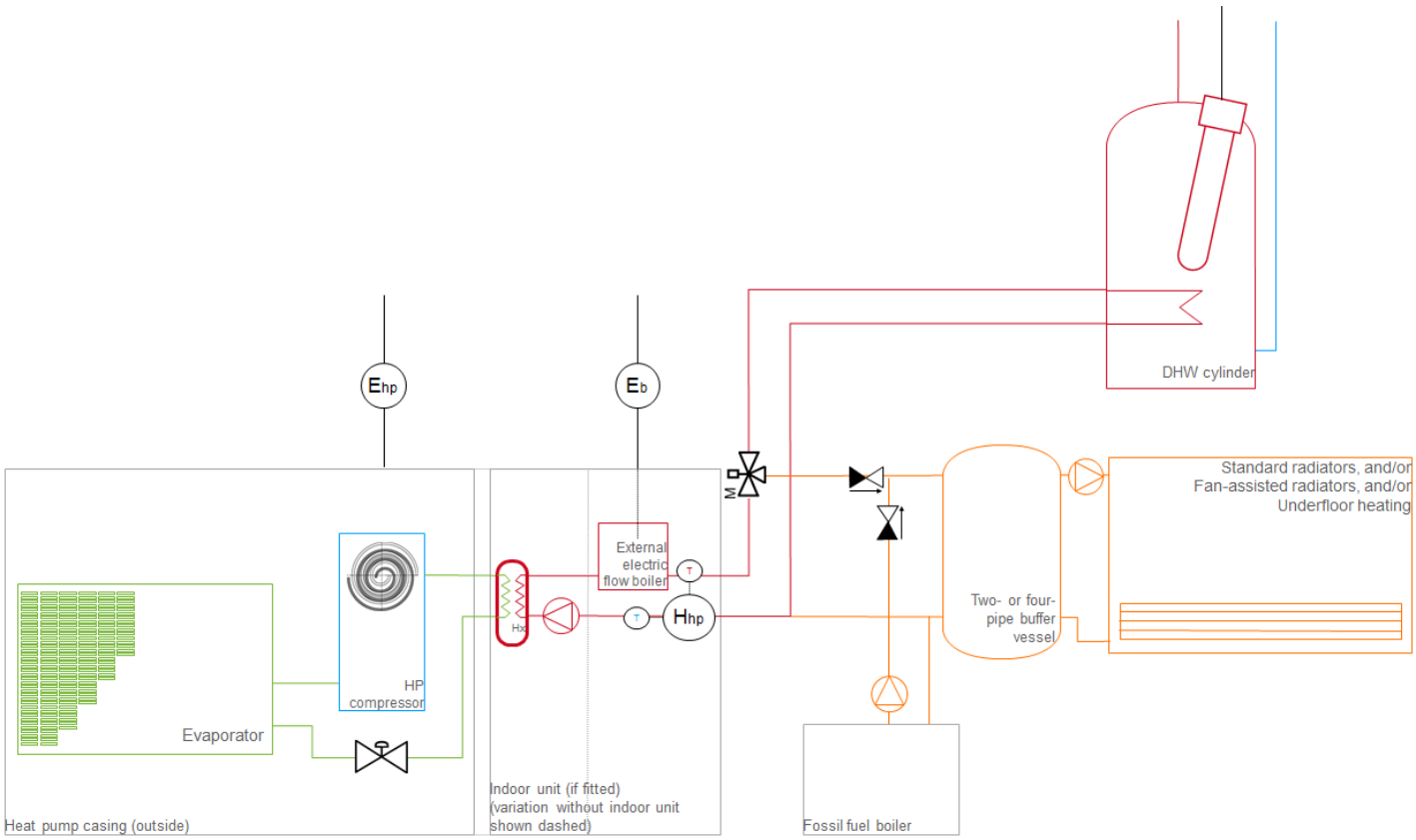


Figure 11: Split-system air-source heat pump with metering option 2: 1 heat meter (integrated), 2 electricity meters

Alternatively, in the example in Figure 11, the heat measurement could be integrated into the internal unit by the heat pump manufacturer. The electricity measurement continues to be collected with two electricity meters in Figure 11. This could be further simplified as shown in Figure 12, where the electrical supply to both parts of the heat pump has been combined into a single measurement. Where possible, we recommend this approach as the simplest way to meter this system, which reduces the possibility of error and complexity and cost for consumers.

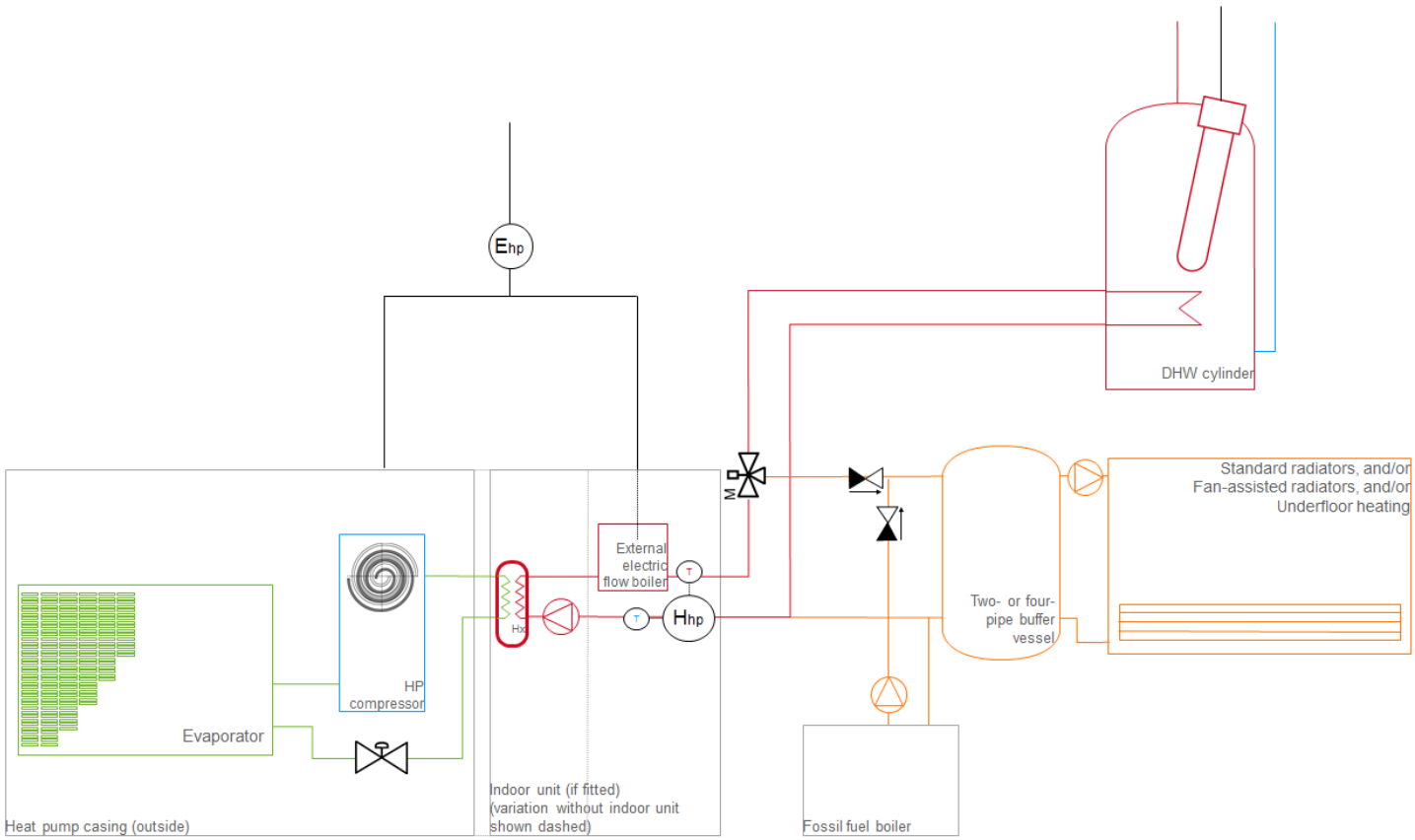


Figure 12: Split-system air-source heat pump with metering option 3: 1 heat meter (integrated), 1 electricity meter

In several of the systems above, it would be possible to meter either side of a circulation pump. We do not intend to mandate a specific approach to this. We only require that, where the heat generated by a circulation pump is included in the heat output measurement, the energy input to the circulation pump is included in the overall energy inputs measurement. This is only required for heat pumps.

2. Meter Requirements and Considerations

This section sets out our policy for meter requirements and also contains some suggestions for what we consider to be best practice. As mentioned in our introduction, this document is intended to provide more information to those choosing to install before the start of the scheme. The final requirements will be subject to the necessary approvals and we are working closely with Ofgem and MCS to develop further guidance which will eventually supersede this document as appropriate.

Heat Meters

Requirements

Our policy is that all heat meters used to meter for payment in the domestic RHI will need to consist of a flow meter, matched pair of temperature sensors and a calculator, as well as meet the following requirements:

1. Comply with the relevant requirements set out in Annex I to the 2004 Measuring Instruments Directive (MID)[3];
2. Comply with the specific requirements listed in Annex MI-004 of the MID;
3. Fall within accuracy Class 3 or better as defined in Annex MI-004 of the MID;
4. Must not in any way have been tampered with to affect meter readings of the installation.

We recognise that it is possible to purchase heat meters either as individual components or as a kit purchased from a single manufacturer (i.e. a heat meter package). For simplicity, we recommend the latter though both options are anticipated to be eligible for the scheme.

We recognise that some systems may use a heat-conveying fluid that is a mixture of antifreeze and water. In these cases, we do not require that the heat meter chosen be selected specifically for that fluid. Instead, a water-calibrated heat meter may be used and DECC will assume that the water-calibrated meter has over-recorded the heat output by a fixed percentage. DECC and Ofgem are currently undertaking research on the effect of different antifreeze concentrations on heat meter accuracy. We recognise that this approach introduces some inaccuracy; however, given the maximum permissible error of MID Class 3 meters and the scale of domestic heating systems, we feel that this approach provides the best compromise between minimising complexity and cost for consumers and providing a reasonable accuracy of measurement for payment. It also reduces the complexity of delivering the scheme.

A heat meter may be integrated into the heat pump or biomass boiler in question. In such cases, the meter will still need to meet the criteria above. In many cases, integrating the heat meter into the biomass boiler or heat pump unit could significantly reduce complexity for consumers and installers. Where possible, we encourage manufacturers to take this approach.

For some air-source heat pumps, when the system operates in defrost mode, heat may be conveyed from the home to the evaporator. We do not require bi-directional heat meters for any systems and will make an assumption for losses due to defrost, as discussed in Section 3.

[3] Directive 2004/22/EC of the European Parliament and of the Council of 31 March 2004 on measuring instruments http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:135:0001:0080:EN:PDF

Points to consider

1) Integrated meters (integrated with the renewable heating equipment) could be a useful way to avoid installation errors and to make life easier for consumers to claim RHI payments.

2) It is important that the resolution of the heat meter be sufficient to meter the heat output. In particular, when metering the domestic hot water drawn from a cylinder, it's important to choose a meter capable of recording short hot water draw-offs, for example, in many cases, a resolution of 1 pulse per 1 Wh may be required. Meters for measuring domestic hot water delivered to the outlets need to be carefully selected. Using a lower resolution or low-quality heat meter could result in heat being under-recorded and the consumer not receiving the full benefit of their RHI payment.

Electricity meters (for heat pumps only)

Requirements

All electricity meters used to meter for payment in the domestic RHI will need to comply with the following criteria:

1. Comply with the relevant requirements set out in Annex I to the 2004 Measuring Instruments Directive (MID);
2. Comply with the specific requirements listed in Annex MI-003 of the MID;
3. Fall within accuracy Class A as defined in Annex MI-003 of the MID;
4. Be installed by a competent, suitably qualified and registered person in accordance with industry standards and manufacturers' instructions, including with respect to safety requirements.
5. Must not in any way have been tampered with to affect meter readings of the installation.

Gas meters

Requirements

Where gas is an input to the renewable heating installation components for which heat is being measured, such as could be possible in some hybrid systems where the heat pump or biomass installation is combined with a gas boiler, then gas will need to be metered in the same way that electricity has been in the worked examples. If it is possible to meter the heat output from the renewable heating installation alone, without including the heat output from the gas boiler, then gas does not need to be measured and we would strongly recommend that approach as a simpler alternative.

If metering gas, the gas meter in question will need to comply with the following criteria:

1. Comply with the relevant requirements set out in Annex I to the 2004 Measuring Instruments Directive (MID);
2. Comply with the specific requirements listed in Annex MI-002 of the MID;
3. Fall within accuracy Class 1.5 as defined in Annex MI-002 of the MID;
4. Be installed by a competent, suitably qualified and registered person in accordance with the requirements of the Gas Safety (Installation and Use) Regulations 1998, industry standards and manufacturers' instructions, particularly with respect to safety requirements;
5. Must not in any way have been tampered with to affect meter readings of the installation.

3. Calculating the renewable heat produced

The energy measurements will often need to be combined to calculate renewable heat. It is our intention to work with Ofgem to develop a process to assist with this calculation in order to simplify this as much as possible. For information, the details of the calculation are presented below:

Renewable heat

As discussed in the introduction, our policy classifies all heat output from biomass installations as renewable (unless composed of a hybrid system that includes a fossil fuel boiler). However, for heat pumps, our policy requires that electric power and/or gas consumed by a heat pump be subtracted from the heat output to calculate the renewable heat output from the heat pump.

Heat conveying fluids composed of antifreeze/water mixtures

As discussed in Section 2, DECC's policy is to assume that water-calibrated heat meters have been used in all cases. If a system uses a heat-conveying fluid that is composed of an antifreeze/water mixture then a fixed percentage reduction will be applied to the heat measured to account for the incorrect calibration.

Defrost

As discussed in Section 2, where an air-source heat pump uses a defrost mechanism that draws heat from the home, DECC's policy is to assume that this also causes a fixed percentage reduction in heat output from the heat pump over one year. A multiplier will be used in the renewable heat equation to account for this.

Losses from an integrated domestic hot water cylinder

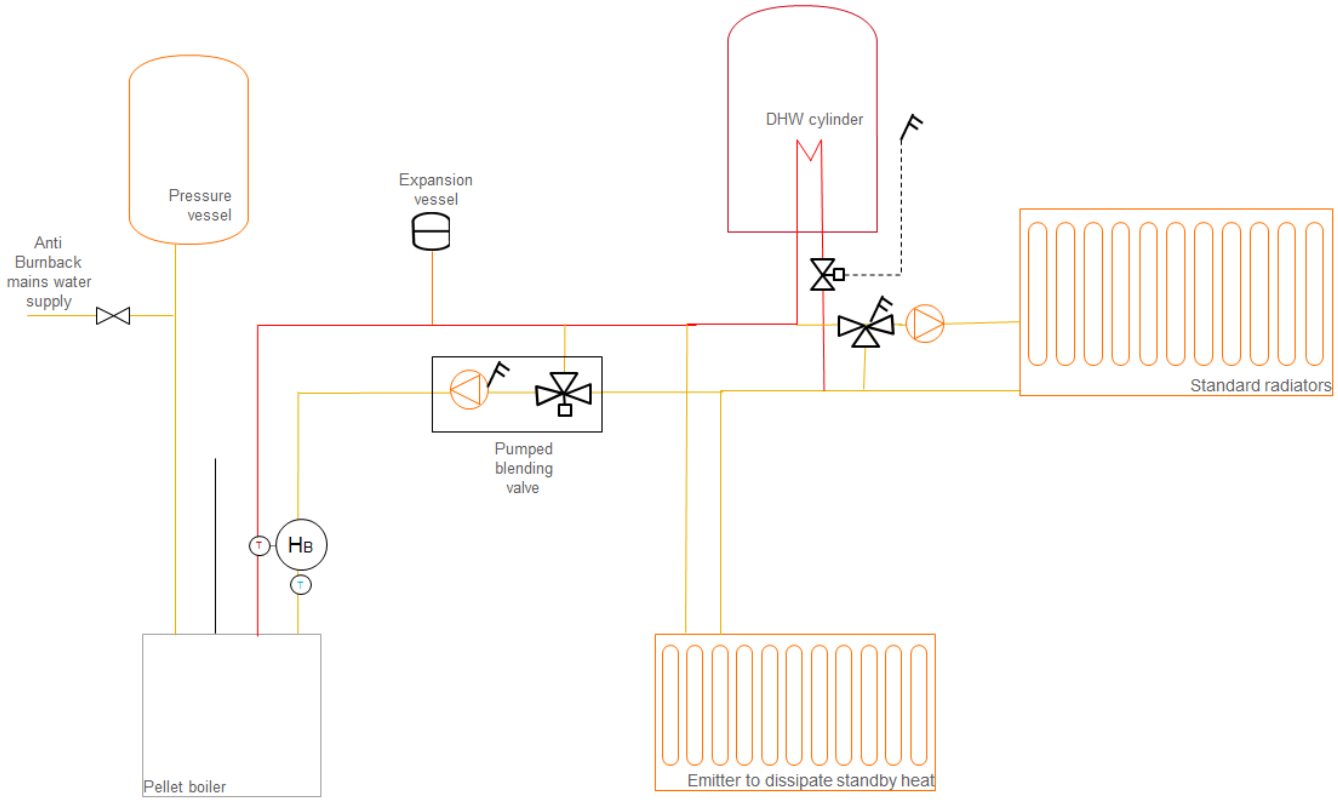
We understand that it may not always be possible to meter in comparable locations for different types of renewable energy systems. In particular, where a domestic hot water cylinder has been integrated into a unit and where it has not been possible to meter prior to the cylinder, losses from the cylinder must be taken into account in order to provide a fair comparison between systems. In such cases, DECC's policy is to assume a reasonably high cylinder storage efficiency (expected to be around 70 %) and to divide the measured heat output from the cylinder by this percentage to estimate the heat that would have been measured prior to the cylinder. This simplified approach aims to provide as fair a comparison as possible whilst incentivising more efficient cylinders.

Pellet biomass stoves with back-boilers

For these systems, it will not be possible to meter the heat output to the room, only the heat output to the heat-conveying fluid of the back-boiler. In this case, our policy is to assume a fixed percentage of overall heat is supplied to the room and multiply the metered heat from the boiler by this fixed percentage, expected to be around 20 %.

To illustrate the above in more detail, the following examples show the metering locations and 'renewable heat equations' that would be generated by this approach:

Worked Example 1: A pellet biomass boiler providing space heating and domestic hot water in a second home

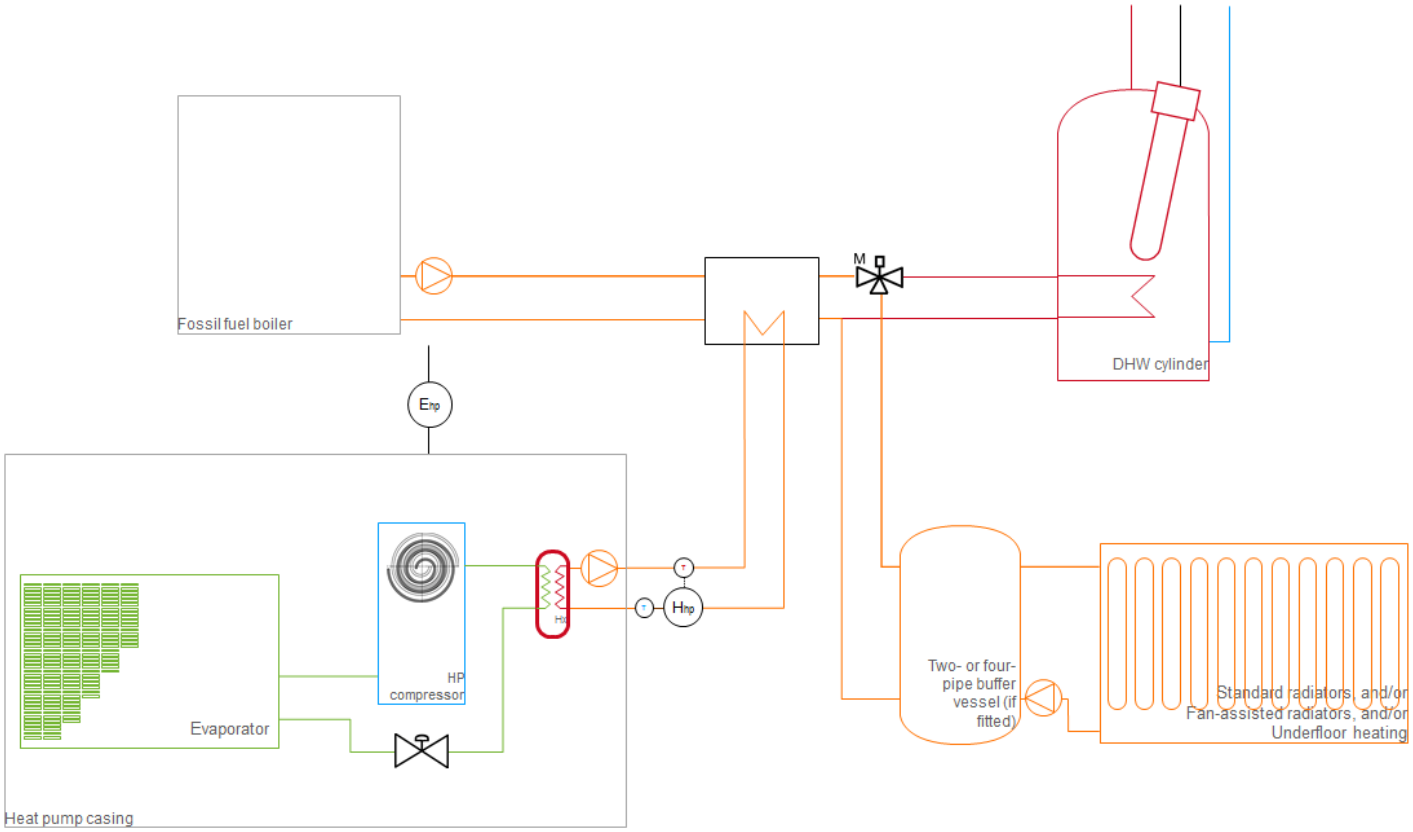


(Figure 2 repeated)

For the biomass system in worked example 1, all heat output is considered to be renewable therefore the renewable heat equation is as follows:

Renewable heat = H_B

Worked Example 2: An air-source heat pump providing both space heating and domestic hot water with a back-up fossil fuel boiler



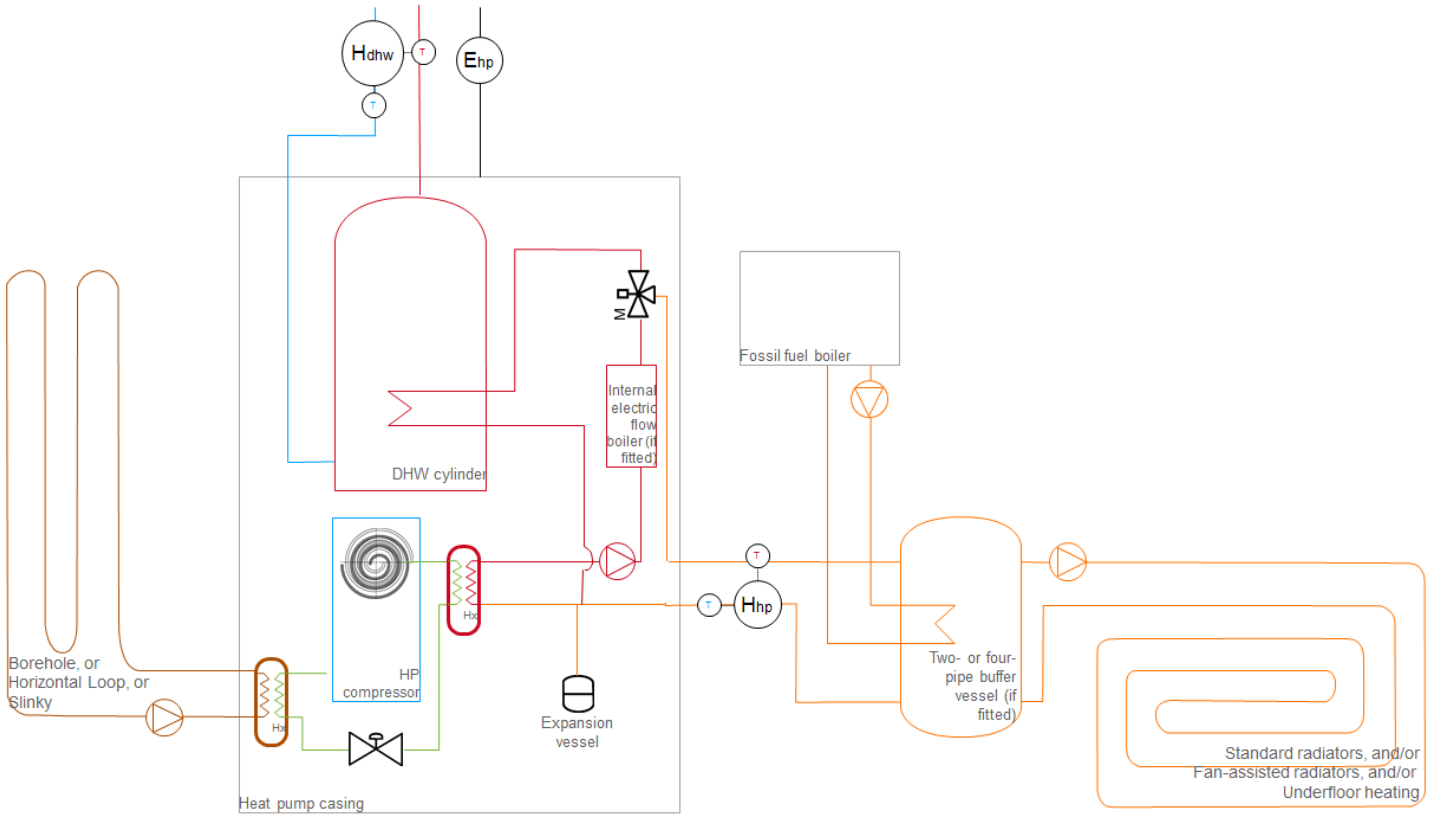
(Figure 4 repeated)

The system in worked example 2 has a heat conveying fluid that is an antifreeze/water mixture and uses a defrost mechanism that draws heat from the home. The defrost and antifreeze multipliers have been assumed for this analysis to be 97 % and 95 % respectively.

Renewable heat= H_{hp}(defrost assumption x water/antifreeze mixture assumption)-E_{hp}

Renewable heat= H_{hp}(97 % x 95 %)-E_{hp}

Worked Example 3: A ground-source heat pump with integrated domestic hot water cylinder



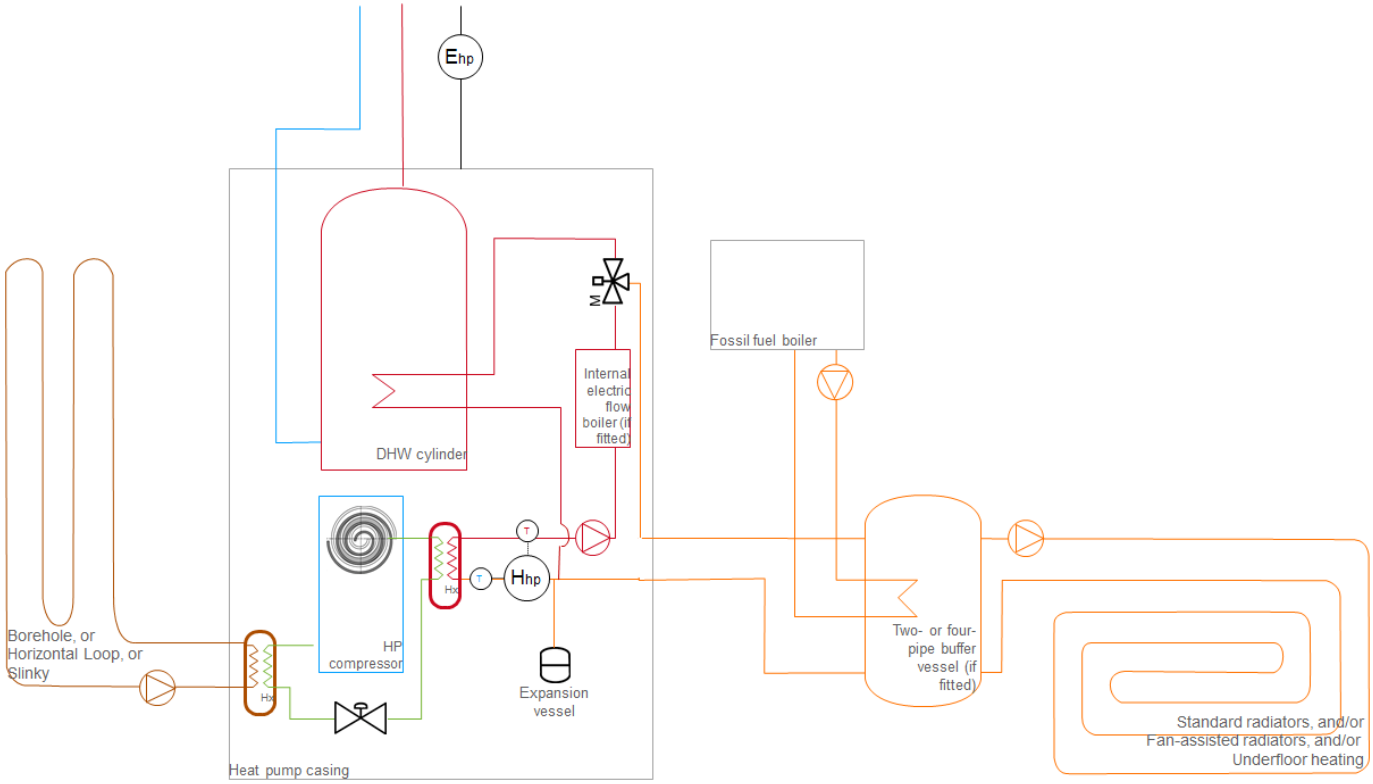
(Figure 7 repeated)

The system in worked example 3 is a ground-source heat pump system so has no defrost function. It also doesn't have antifreeze in its heat emitter circuit. However, it has an integrated hot water cylinder and therefore losses from the cylinder must be considered. These have been assumed to be approximately 70 % for the purposes of this document:

$$\textit{Renewable heat} = H_{hp} + H_{dhw}/70\ \% - E_{hp}$$

The system has a heat meter, H_{dhw}, which is metering hot water drawn from the domestic hot water cylinder. As discussed in Section 2, it's important that this meter is specified - and has sufficient resolution - to measure short hot water draw-offs. In many cases, a resolution of 1 pulse per 1 Wh could be sufficient.

Alternatively, the metering could be integrated into the unit as shown in Figure 8:



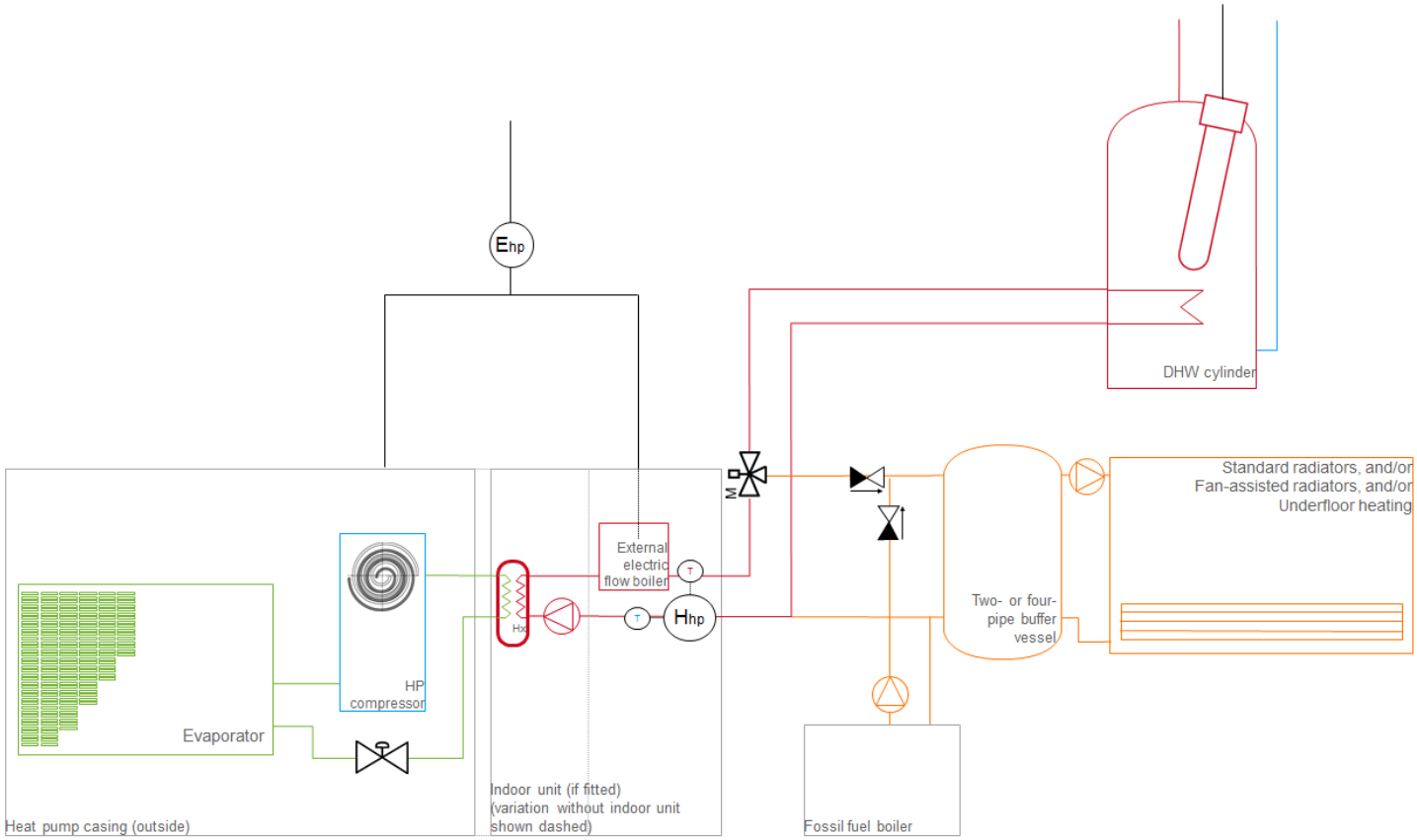
(*Figure 8 repeated)*

If the metering is integrated as above, then the heat output to the space heating and domestic hot water do not need to be taken account of separately which simplifies the metering and the renewable heat calculation. Instead, the H_{hp} heat meter directly records all heat output from the heat pump. In this case, renewable heat is calculated as follows:

Renewable heat= $H_{hp} – E_{hp}$

In the example above, it's important that the electricity meter reading only includes the same components as are included in the heat measurement. Importantly, this means that, in this particular example, the internal electric flow boiler should not be included in the electricity measurement and neither should the circulation pump.

Worked Example 4: A split-system air-source heat pump providing space heating and domestic hot water



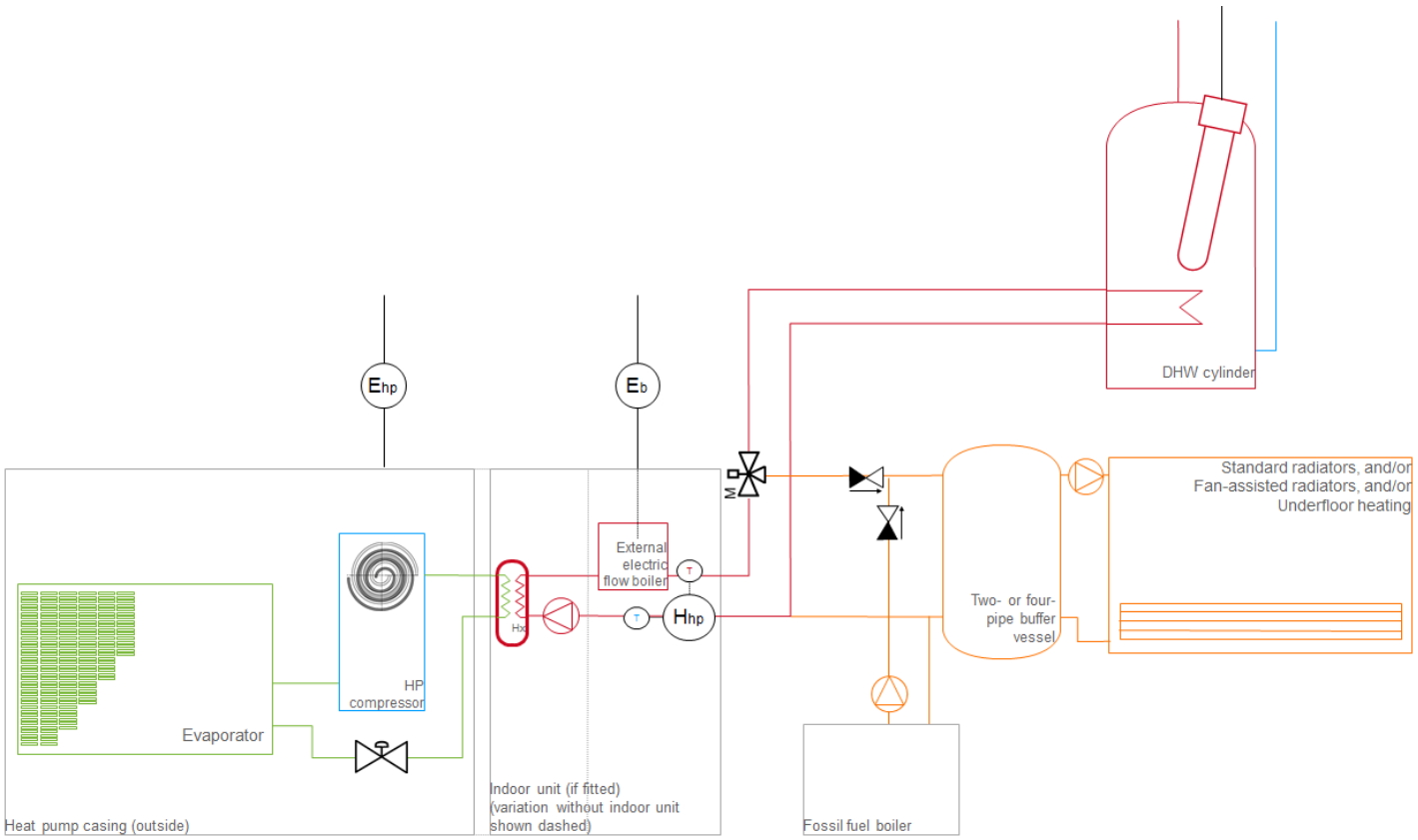
(Figure 12 repeated)

For the split-system air-source heat pump metered in Figure 10, there is only one electricity meter and one heat meter. The air-source heat pump uses a defrost mechanism that draws heat from the home but the heat-conveying fluid has no antifreeze content. In this case, the following renewable heat equation would apply where we assume that the defrost multiplier is 97 %:

Renewable heat= (H_{hp} x defrost assumption)-E_{hp}

Renewable heat= (H_{hp} x 97 %)-E_{hp}

The example above assumes that the electrical supply measurement has been combined into a single electricity measurement. If the unit is wired so that two electricity meters are required, as in the following example, then the renewable heat equation is calculated as follows:



(Figure 11 repeated)

Renewable heat= (H_{hp} x defrost assumption)-(E_{hp} + E_b)

Renewable heat= (H_{hp} x 97 %)-E_{hp} - E_b

We recommend installing the minimum number of meters possible to reduce the risk of installation and meter reading errors.

Annex 1: Worked example figures

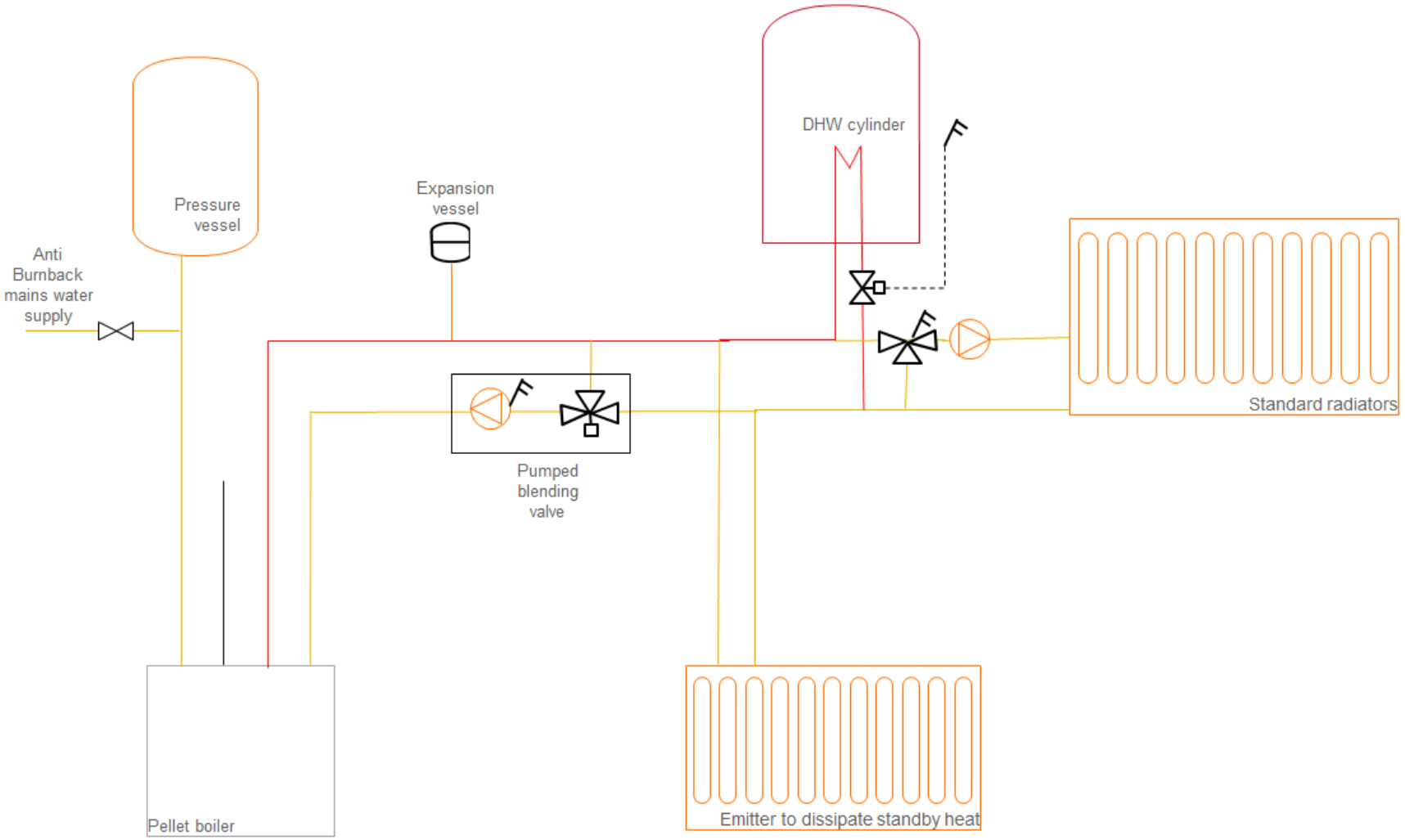


Figure 1: Pellet biomass boiler

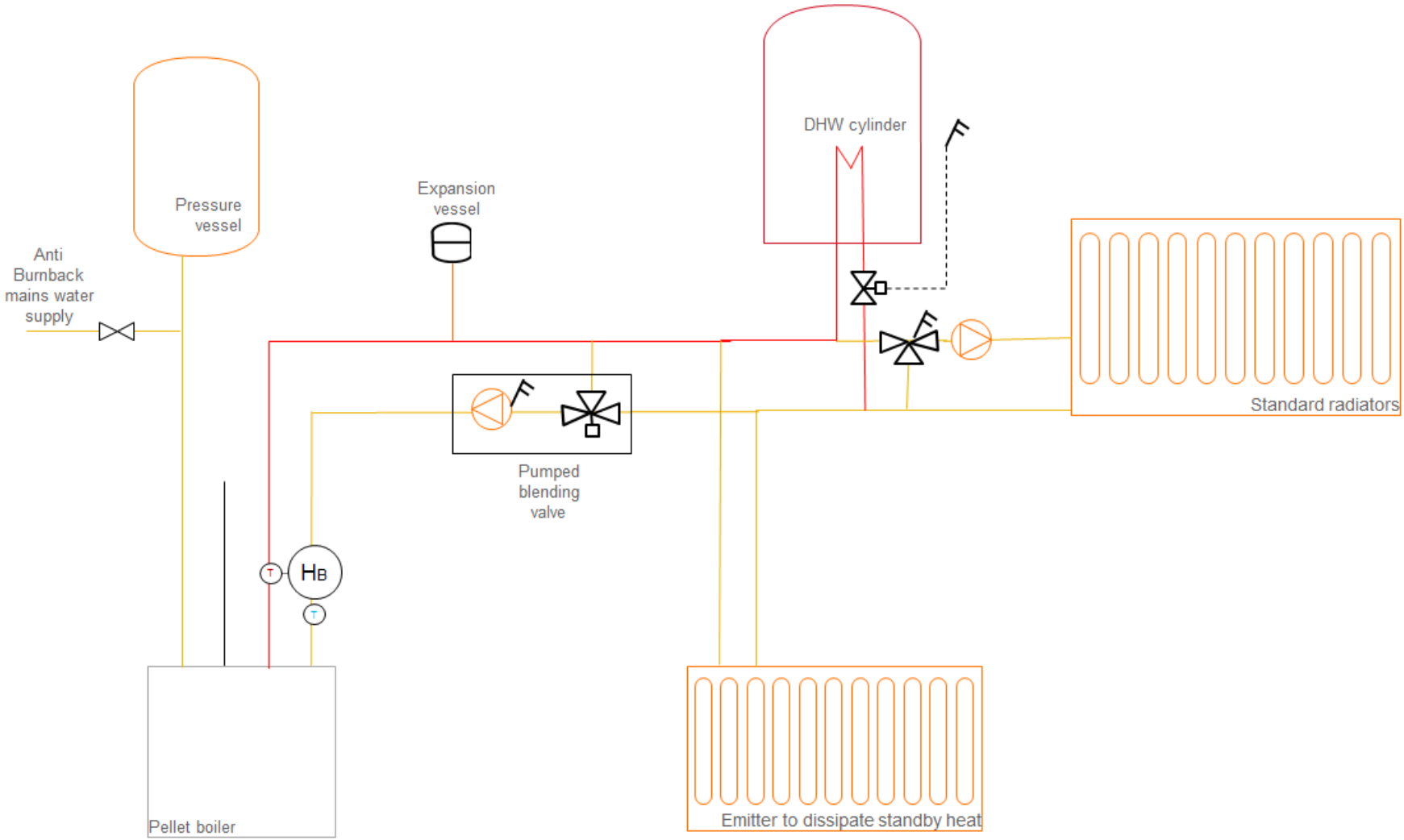


Figure 2: Pellet biomass boiler with metering option 1: 1 heat meter

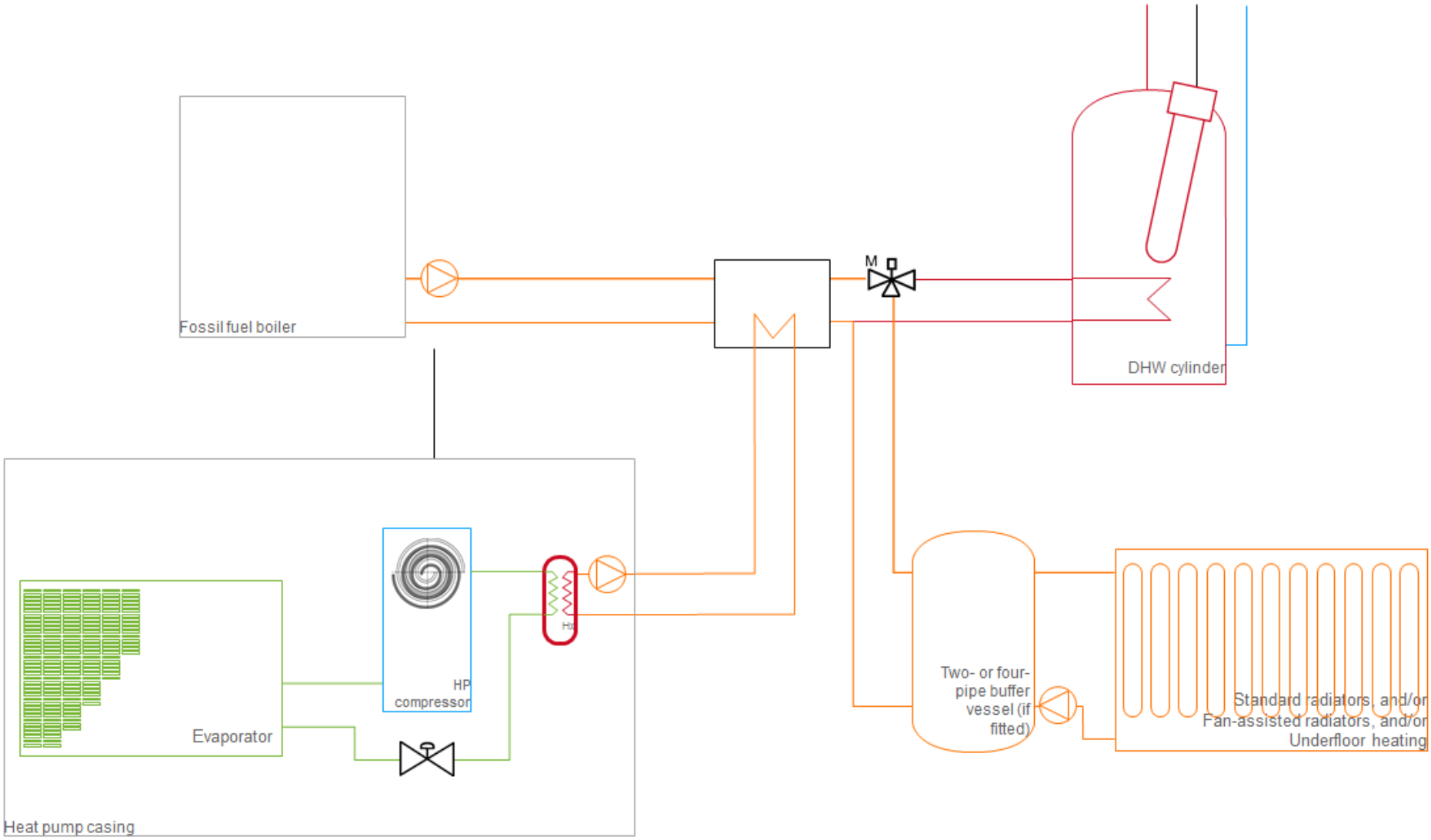


Figure 3: Air-source heat pump with back-up fossil fuel boiler

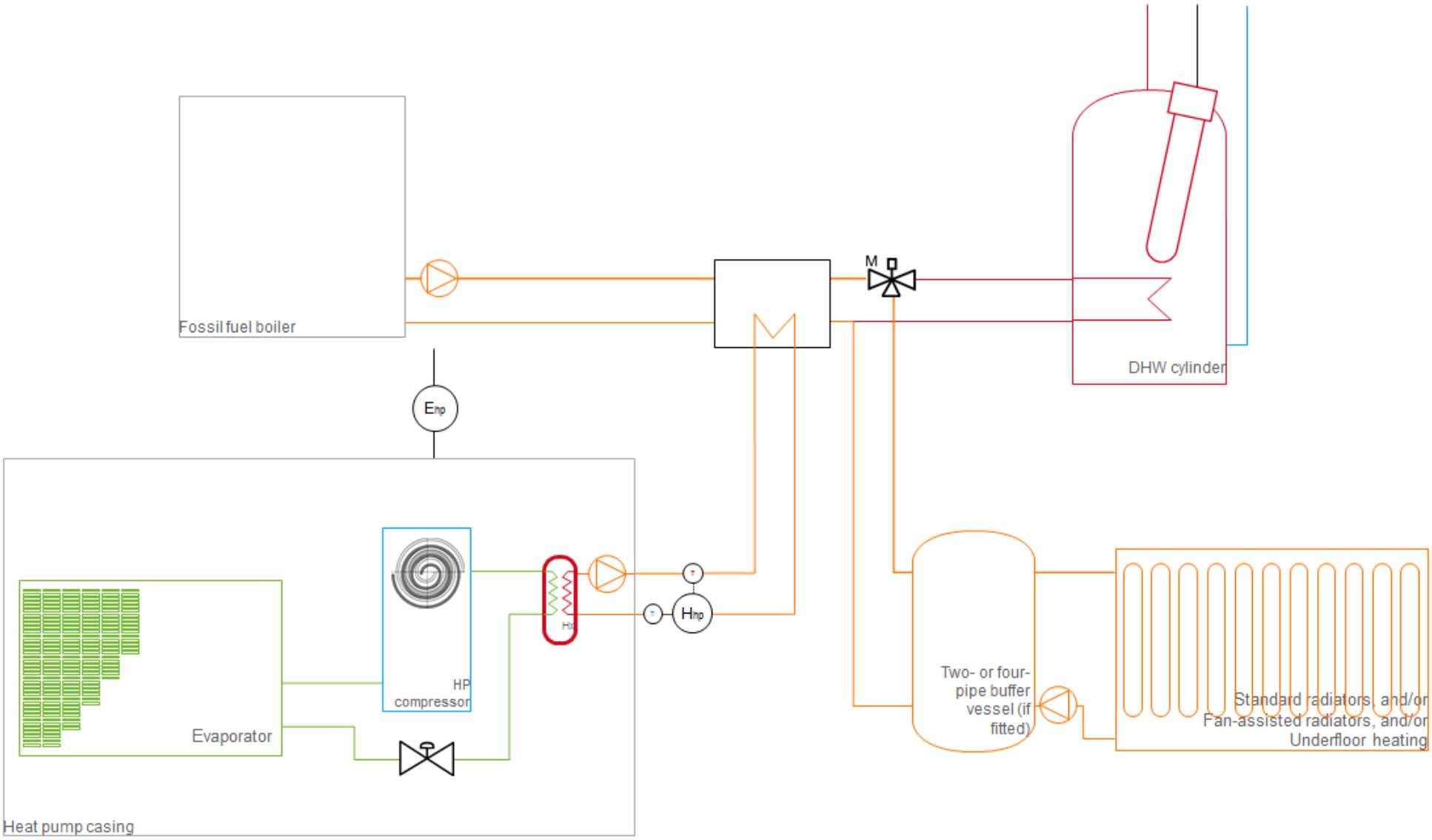


Figure 4: Air-source heat pump with back-up fossil fuel boiler showing metering option 1: 1 heat meter and 1 electricity meter

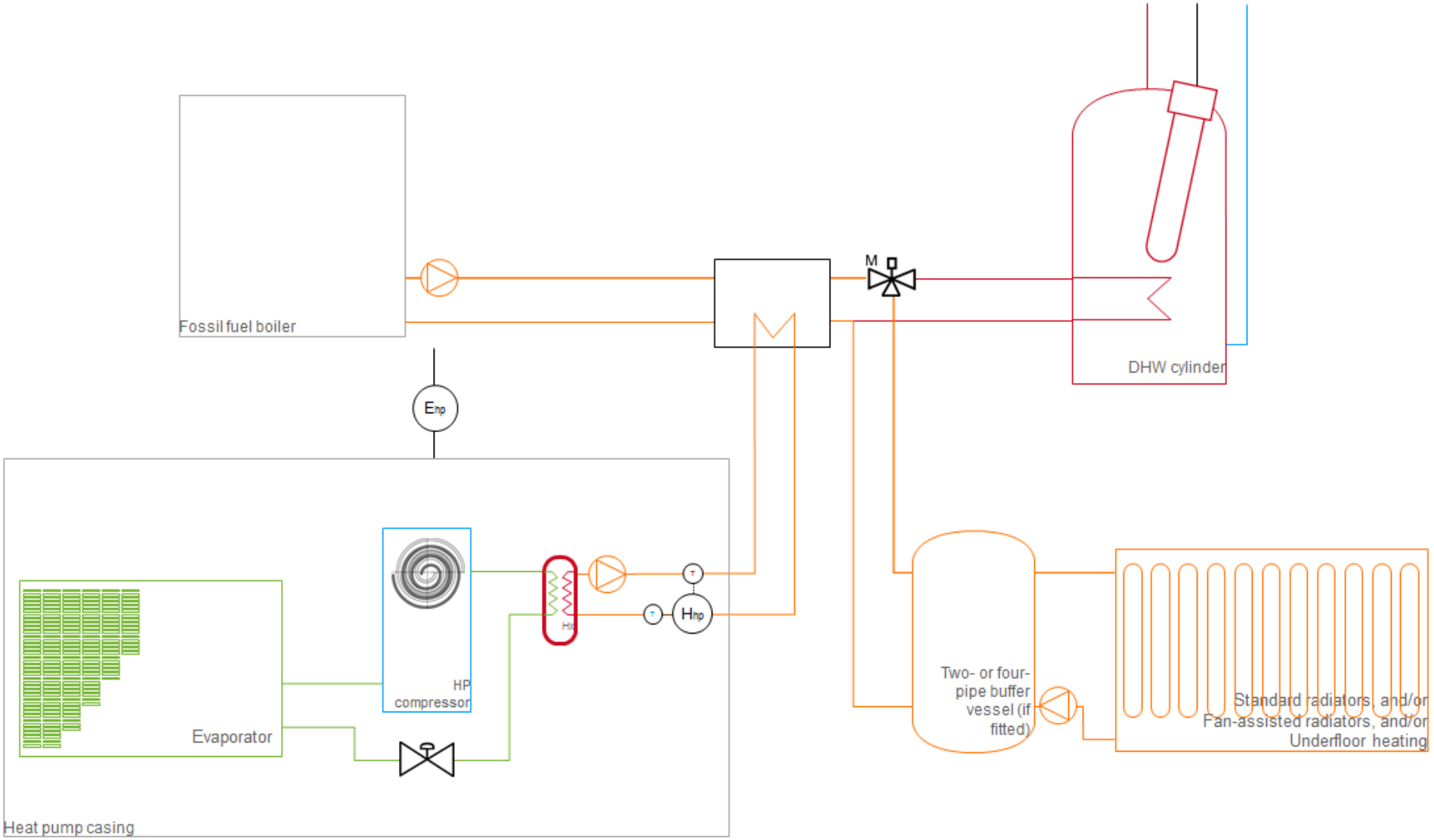


Figure 5: Air-source heat pump with back-up fossil fuel boiler showing metering option 2: 1 heat meter (integrated) and 1 electricity meter

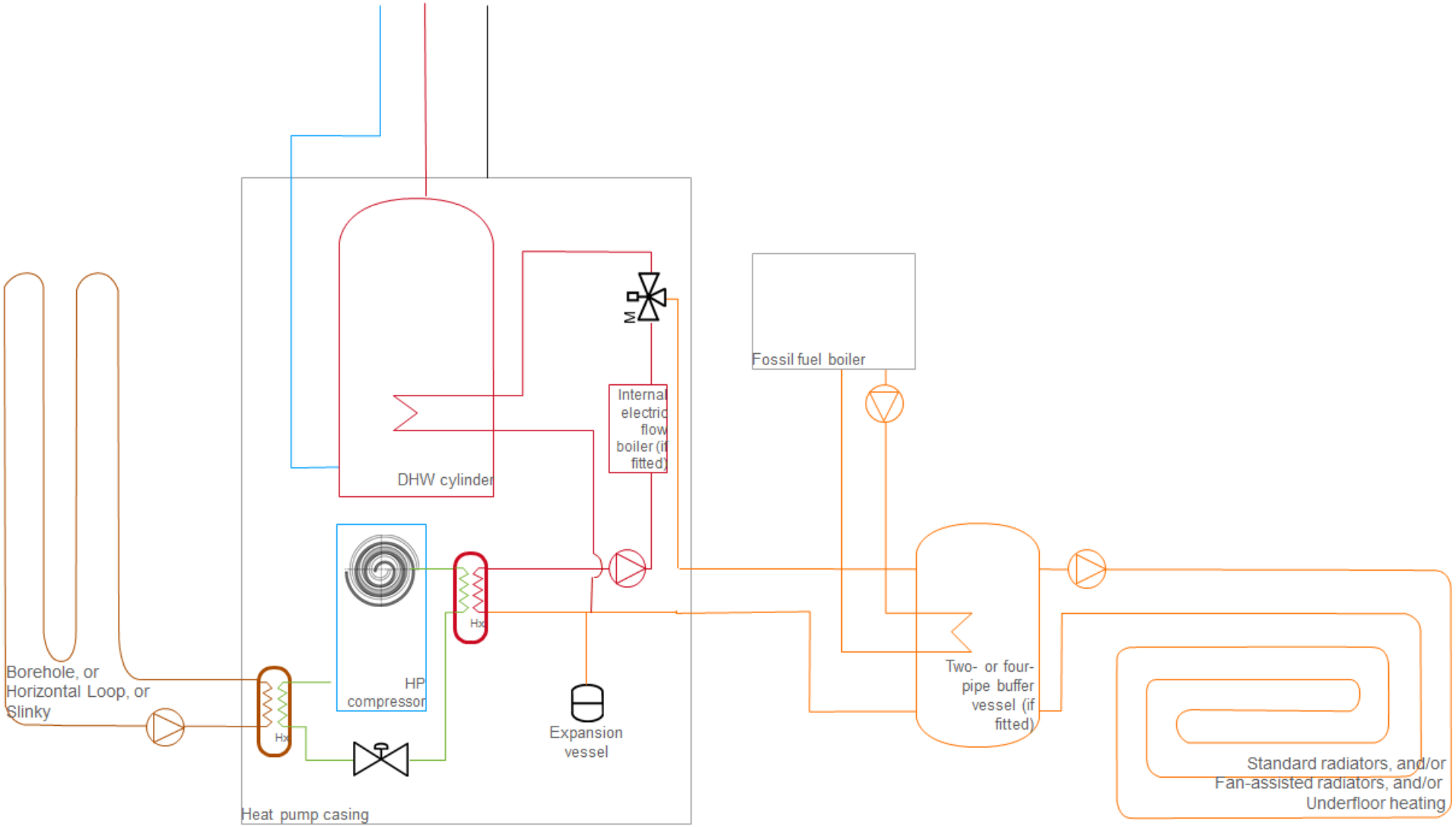


Figure 6: Ground-source heat pump with integrated domestic hot water cylinder

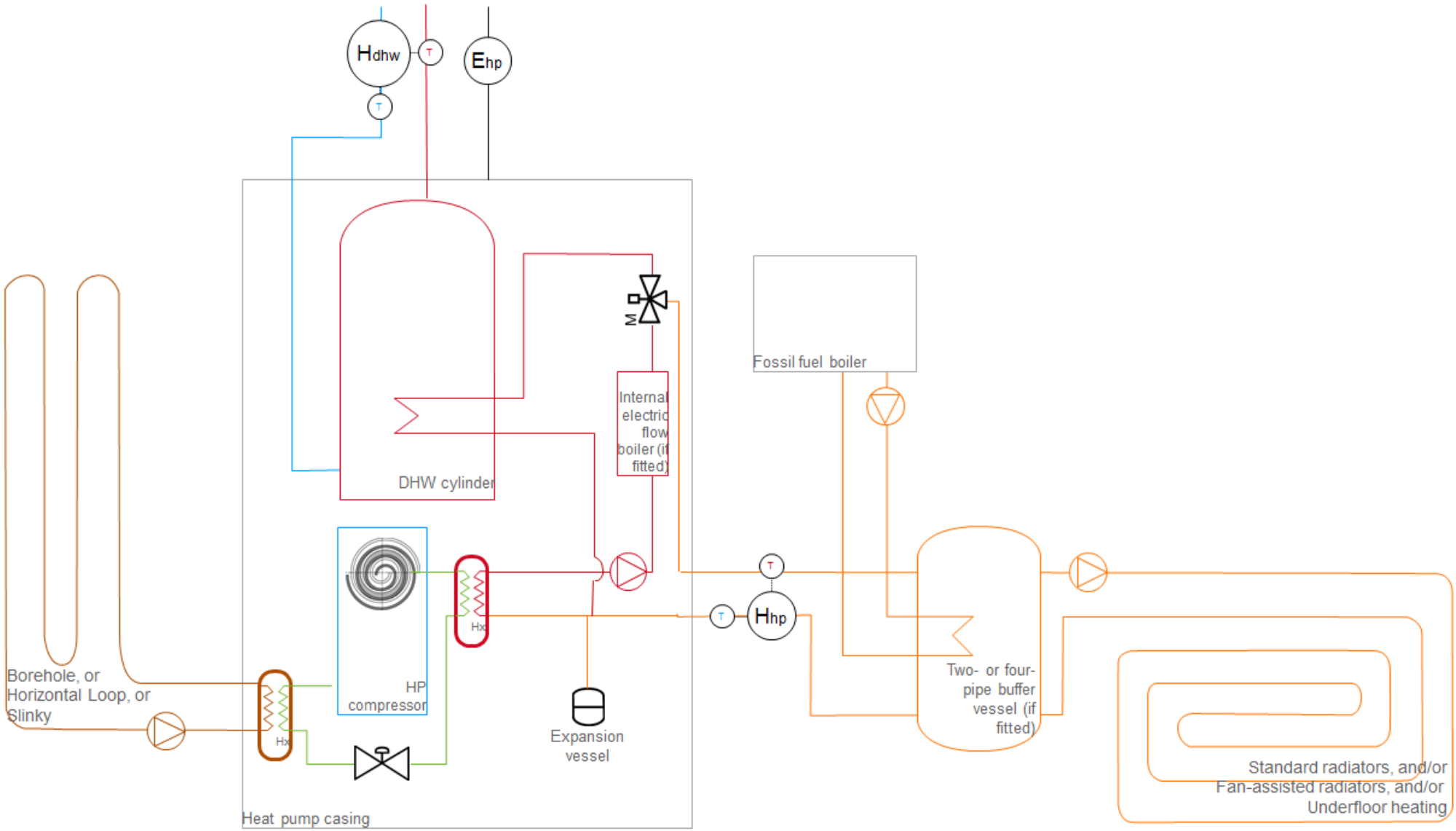


Figure 7: Ground-source heat pump with integrated domestic hot water cylinder and metering option 1: 2 heat meters, 1 electricity meter

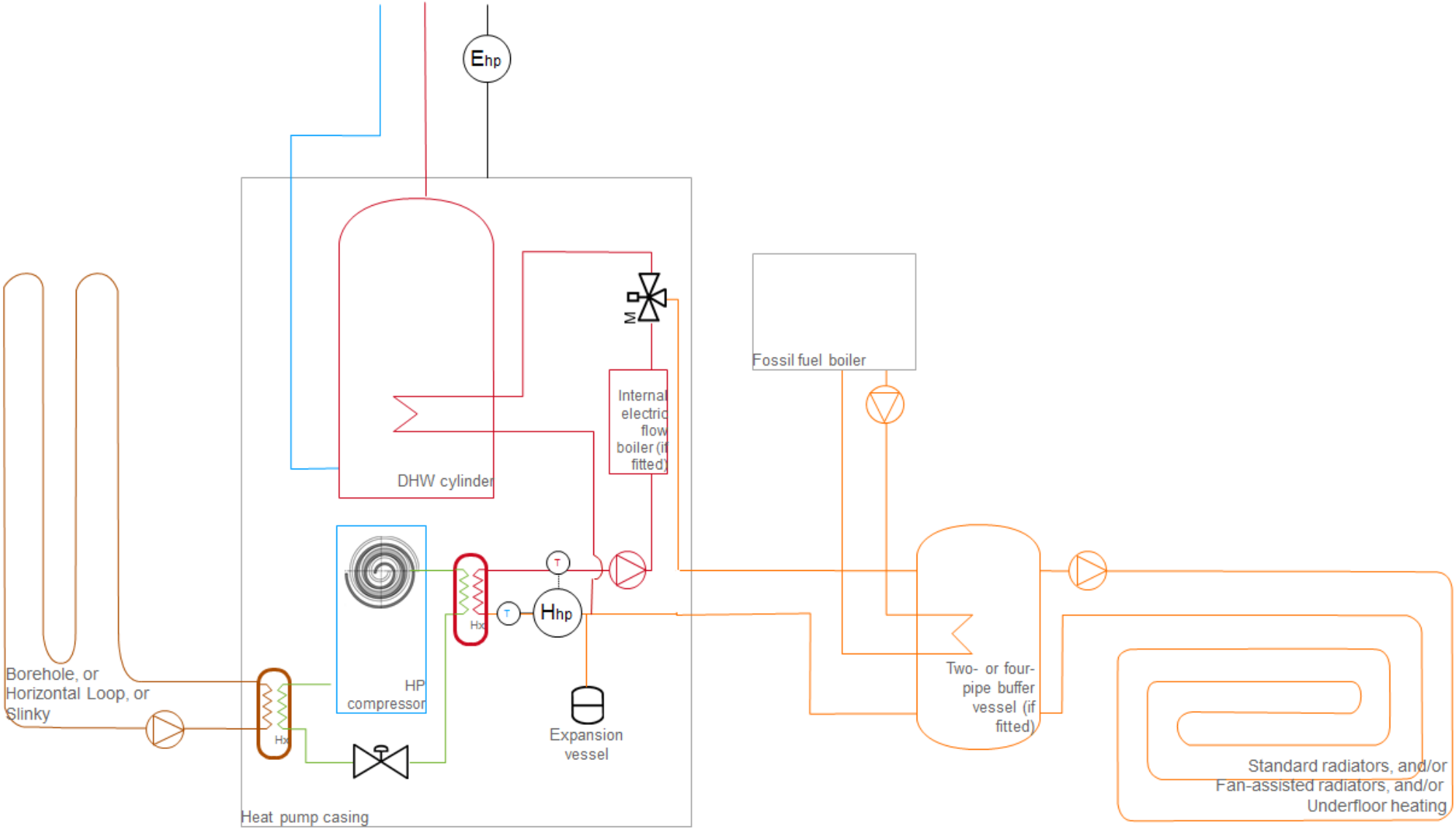


Figure 8: Ground-source heat pump with integrated domestic hot water cylinder and metering option 2: 1 heat meter, 1 electricity meter

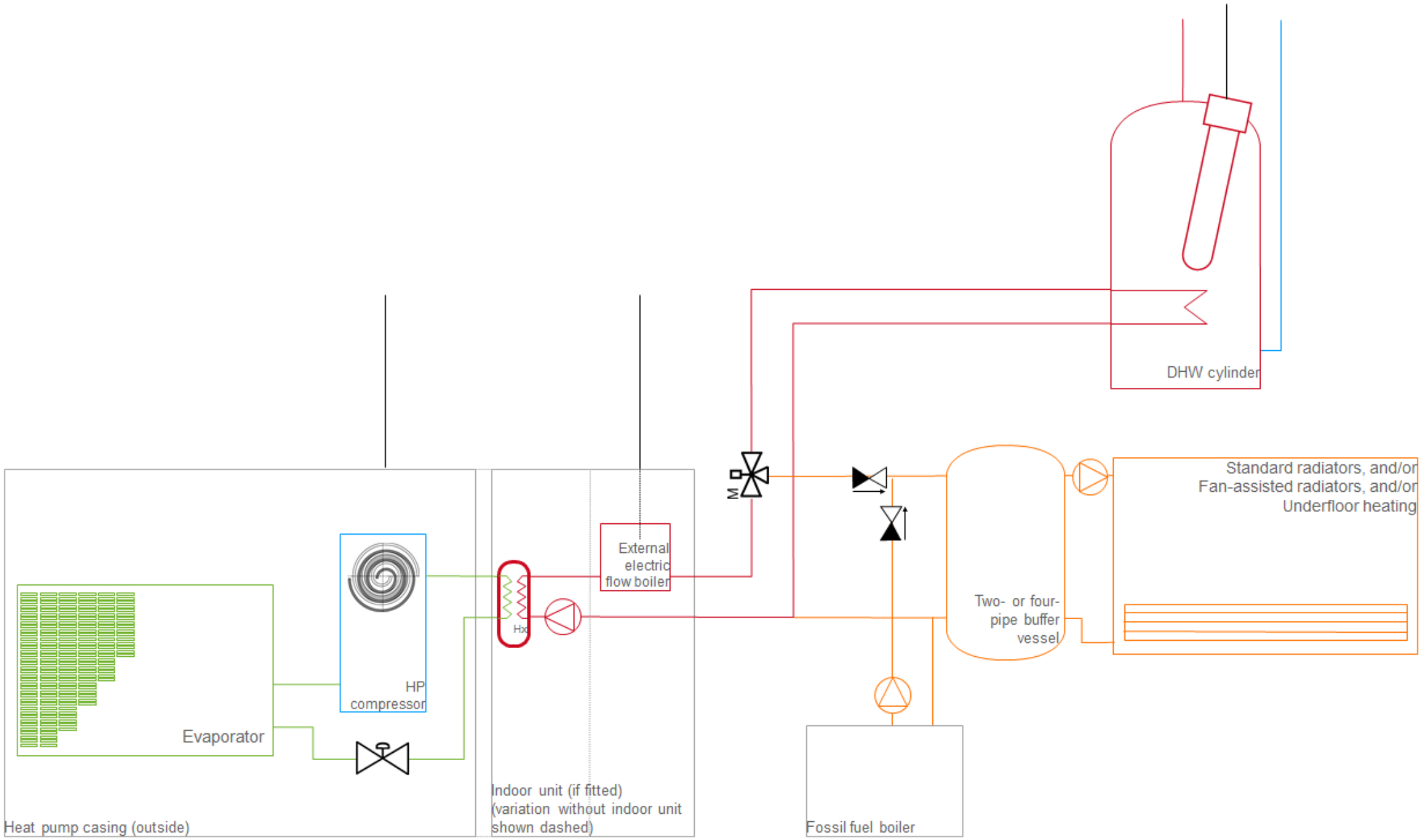


Figure 9: Split-system air-source heat pump providing space heating and hot water

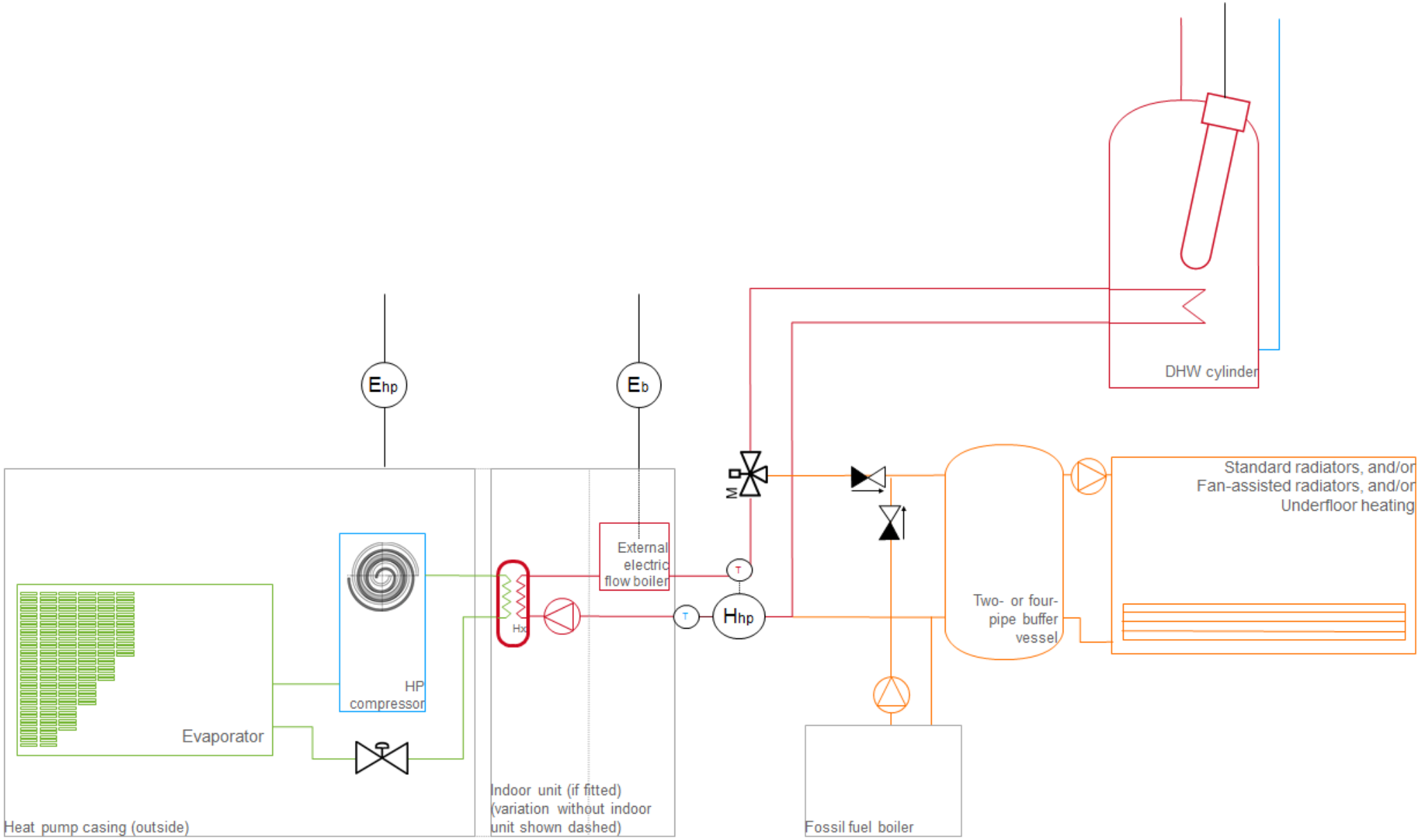


Figure 10: Split-system air-source heat pump with metering option 1: 1 heat meter, 2 electricity meters

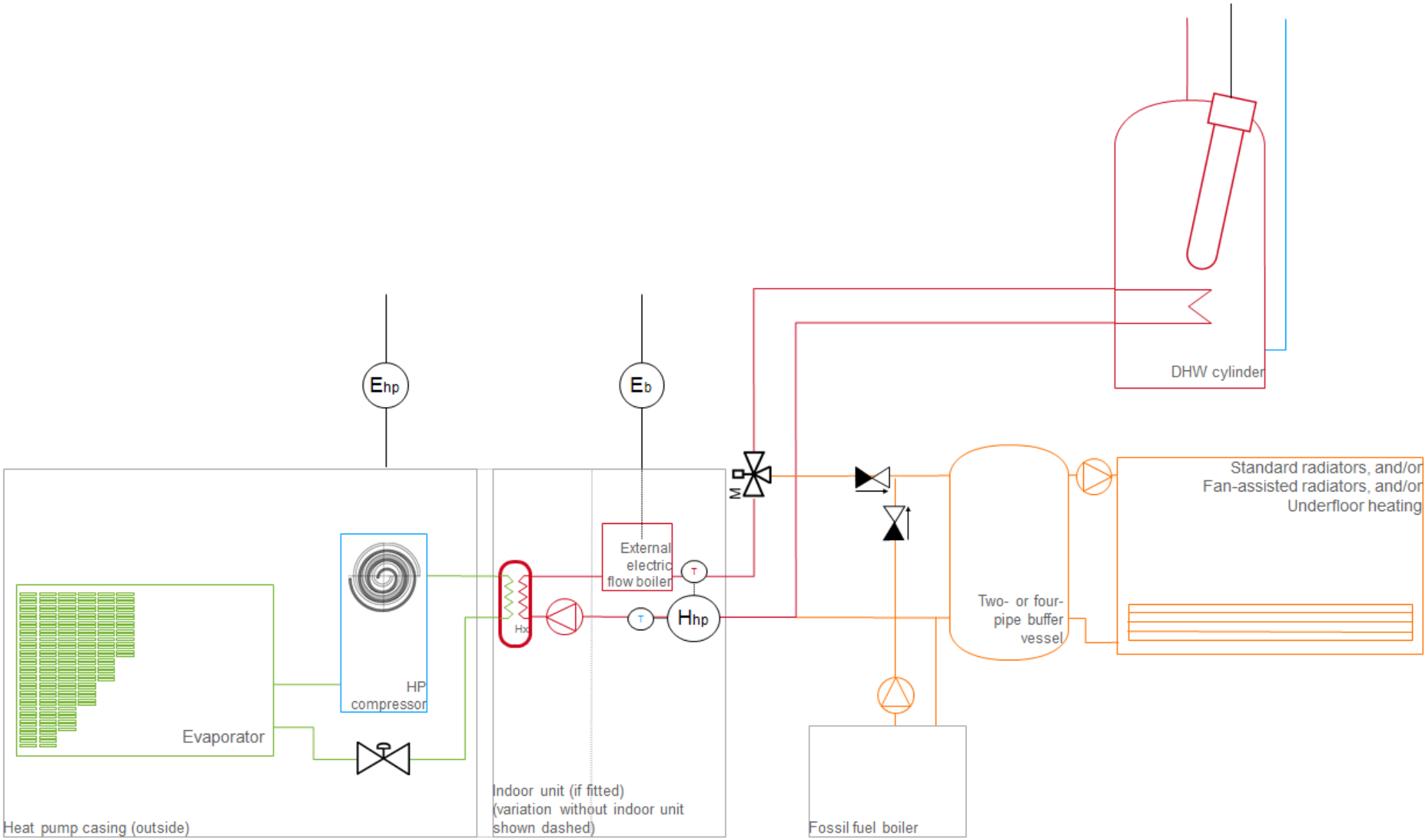


Figure 11: Split-system air-source heat pump with metering option 1: 1 heat meter (integrated), 2 electricity meters

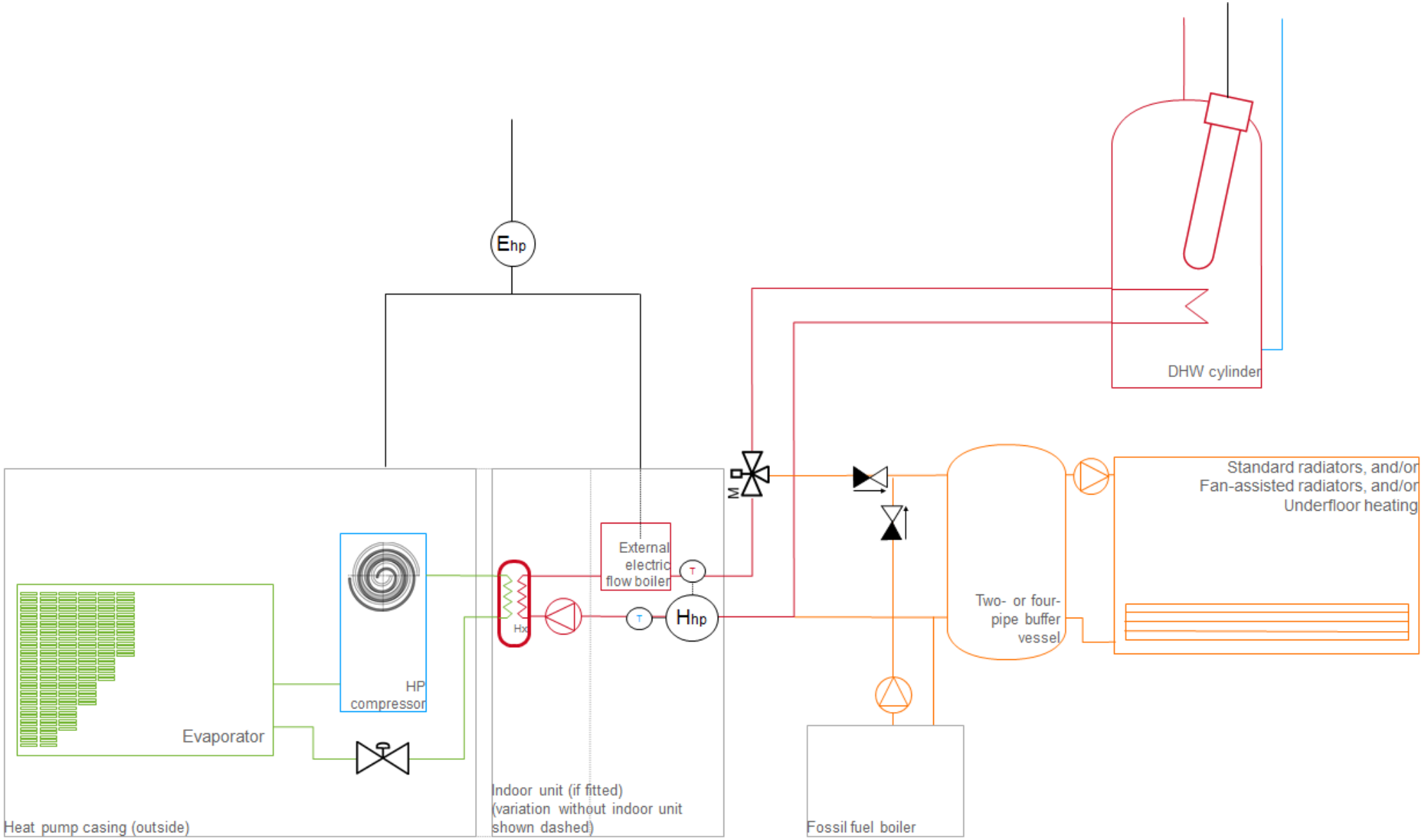


Figure 12: Split-system air-source heat pump with metering option 3: 1 heat meter (integrated), 1 electricity meter

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