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ASHP and Microbore
Installation Flowchart

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Flowchart Information

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List of Abbreviations

Microbore pipework = 6,8, 10, and 12mm pipework diameter

Existing heating system = Gas boiler (non-condensing or condensing)

New heating system = ASHP

Max. = Maximum

Temp. = Temperature

HT = High temperature

F&R = Flow and return

MWAT = Mean water to air temperature

LLH = Low loss header

Important Notes

The flowchart provides a comprehensive guide for installers retrofitting ASHPs for properties with existing microbore central heating systems (also suitable for new builds).

The flowchart is designed to match the operating conditions of the existing heating system (i.e. flow temperature and ΔT) with those of the ASHP. This minimizes the need for costly and disruptive property upgrades, like pipework changes, radiator replacements, or added insulation.

The results of the flowchart are based on an ASHP design temperature of -3°C.

The maximum operating temperature for the Ecodan R290 ASHP is 75°C.

The efficiency of ASHPs decreases at higher flow temperatures.

Assumptions

The existing heating system operated on a flow temperature ranging from 60°C to 75°C.

The new heating system (ASHP) includes anti-freeze valves and uses the freeze stat function on the main RC without glycol.

When commissioned, ASHP would run on weather compensation mode.

Legend

- (Teal circle) **Represents the start or end of a process**
- (Solid arrow) **Indicates the flow between steps** (common path)
- (Grey rectangle) **Denotes a process step**
- (Purple hexagon) **Signifies a decision**
- (Dashed arrow) **Indicates the flow between steps** (less common path)
- (Green) **Denotes a cost effective and minimally disruptive process**
- (Orange) **Denotes a moderate cost and slightly disruptive process**
- (Red) **Denotes a costly and highly disruptive process**

Data Logging Tables:

Record essential information & values as you progress through the flowchart.

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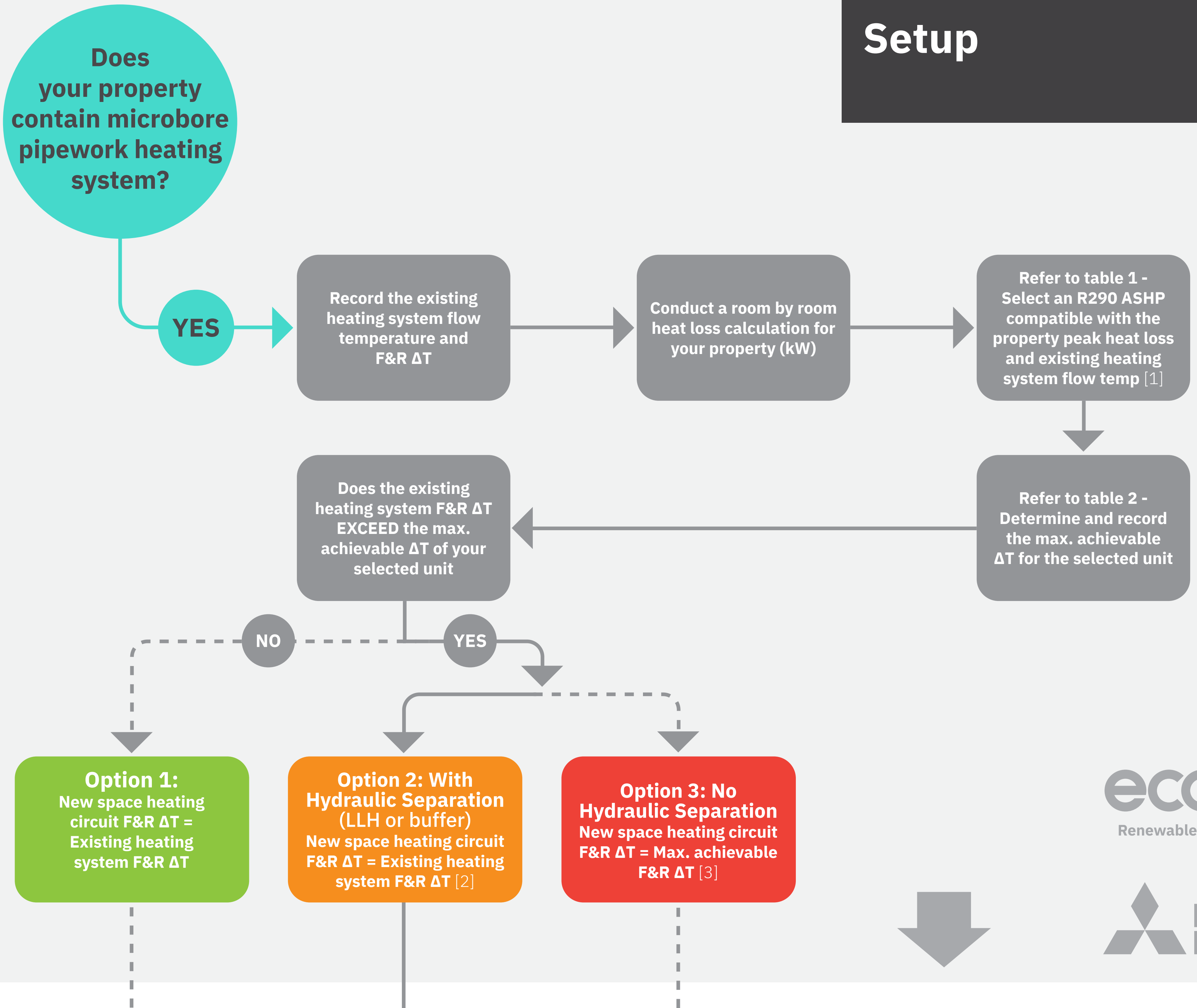
Setup		Section 1			Section 2		Section 3
Room Name	**Heat Loss (kW)**	**Pipework Material**	**Pipework Diameter (mm)**	**Max. Heat Load Across Pipework (kW)**	**Equivalent Radiator (s) Output**	**Existing Radiator (s) Rated Output**	**Required Water Flow Rate, V (L/min)**
Total							

Setup				
Existing Heating System		**ASHP Unit Selected**		**New Space Heating Circuit F&R ΔT**
Flow Temperature (ºC)	F&R ΔT (ºC)	Model	Max. Achievable F&R ΔT (ºC)	Max. Achievable F&R ΔT **OR** Existing heating system F&R ΔT

Section 3			
Manifold Pipework Configuration		**Flow & Return Pipework Configuration**	
Main Pipework (mm)	Max. allowable water flow rate (L/min)	Main Pipework (mm)	Max. allowable water flow rate (L/min)
Pipework Before Manifold (mm)	Max. allowable water flow rate (L/min)	Spine Pipework (mm)	Max. allowable water flow rate (L/min)
Total water flow rate for pipework after manifold 1 (L/min)		Total water flow rate for room pipework connected to spine 1 (L/min)	
Total water flow rate for pipework after manifold 2 (L/min)		Total water flow rate for room pipework connected to spine 2 (L/min)	

Setup



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Step 1:
Select a room within the property

Step 2:
What is the room's microbore pipe material?

Copper

Plastic

Step 3:
Determine the room's microbore pipe diameter

Step 4: Using the pipe diameter found in step 3 and the new F&R ΔT, locate and record the max. heat load across the pipework by referring to table 3 (Copper) or table 4 (Plastic). If exact ΔT value is not listed, select the closest ΔT provided

Does the max. heat load across the room pipework exceed (or match) the room heat loss?

NO

Select the most feasible option with minimal impact to the building fabric

YES

Section 1:
Room Pipework Sizing

Notes

[1] For properties with high heat loss, Ecodan R290 units can be cascaded (only up to 6 units). Please note, only the same model units can be cascaded. Cascading ASHPs will increase the minimum flow rate requirement, and therefore, may necessitate upsizing several pipeworks across the house.

[2] The inclusion of hydraulic separation reduces the potential of upgrading pipework, radiators, insulation etc. as the heating circuit F&R ΔT would be operating at the existing heating system F&R ΔT. It is your choice whether you would like to proceed with a LLH or a buffer vessel as a means for hydraulic separation. Predominantly, a buffer vessel is more efficient in managing heat demand fluctuations and reducing the cycling of the ASHP, leading to better overall energy efficiency. On the other hand, a LLH is more suitable for installations where space is limited and the budget is a concern, as it is smaller and less expensive.

[3] Omitting hydraulic separation may necessitate costly system upgrades as you proceed with the process flow chart. This may include upgrading pipework, radiators, insulation etc.

[4] It's advisable to begin with the most economical insulation choice initially and, if required, gradually increase insulation until max. heat load across the pipe exceeds the room heat loss.

[5] Implementing this option may necessitate an upgrade to the back-end plumbing system which is addressed in 'main secondary pipework sizing' section in flowchart.

[6] Additional pipes must be connected from the main pipework or manifold.

[7] If upsizing pipework is required for multiple rooms, replacing all the microbore pipes with larger diameters (15mm +) throughout the property may be the most convenient option as you will no longer need to operate at high flow temperatures and high F&R ΔT, improving the efficiency of the ASHP. If you would like to proceed with upsizing all pipeworks, you can skip the remaining steps in this flowchart.

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Table 1: Max. capacity for Ecodan R290 range at various flow temps

Flow Temp (°C)	Max. Unit Capacity (kW) PUZ-WZ50VAA (5kW)	PUZ-WZ60VAA (6kW)	PUZ-WZ80VAA (8kW)
75	3.28	3.83	5.67
70	3.48	4.08	6.16
65	3.97	4.67	6.76
60	4.27	5.11	7.16

Table 2: Max. achievable ΔT for Ecodan R290 range at various flow temps

Flow Temp (°C)	Max. Achievable F&R ΔT (°C) PUZ-WZ50VAA (5kW)	PUZ-WZ60VAA (6kW)	PUZ-WZ80VAA (8kW)
75	7.4	8.6	12.8
70	7.8	9.2	13.9
65	8.9	10.5	15.2
60	9.6	11.5	16.1

Note: Max. heat load values presented in tables 1 & 2 were derived based on a design temperature of -3°C.

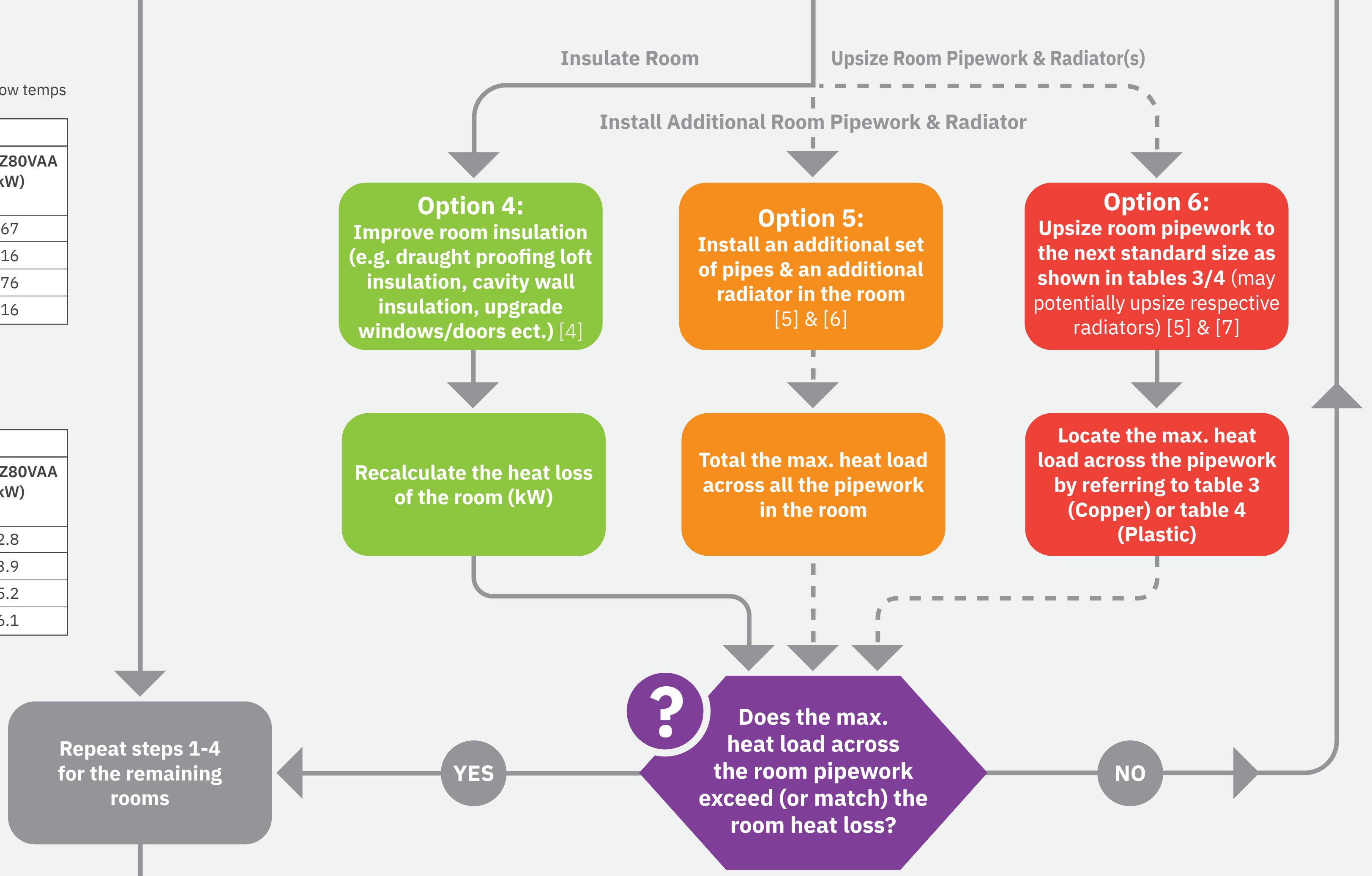

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Table 3: Max. heat load across various **copper pipes** at varying F&R ΔT for secondary circuit.

Pipe Diameter (mm)	Max. Heat Load Across Room Pipework, Q (kW) ΔT = 5°C	ΔT = 7.5°C	ΔT = 10°C	ΔT = 12.5°C	ΔT = 15°C	ΔT = 17.5°C	ΔT = 20°C
6	0.11	0.16	0.21	0.26	0.32	0.37	0.42
8	0.28	0.41	0.55	0.69	0.83	0.97	1.11
10	0.56	0.84	1.12	1.40	1.68	1.96	2.24
12	0.99	1.48	1.97	2.47	2.96	3.45	3.94
15	1.82	2.73	3.64	4.55	5.46	6.37	7.28
22	5.32	7.98	10.64	13.30	15.96	18.62	21.28

Table 4: Max. heat load across various **plastic pipes** at varying F&R ΔT for secondary circuit.

Pipe Diameter (mm)	Max. Heat Load Across Room Pipework, Q (kW) ΔT = 5°C	ΔT = 7.5°C	ΔT = 10°C	ΔT = 12.5°C	ΔT = 15°C	ΔT = 17.5°C	ΔT = 20°C
6	0.09	0.14	0.18	0.23	0.28	0.32	0.37
8	0.26	0.38	0.51	0.64	0.77	0.89	1.02
10	0.32	0.48	0.64	0.81	0.97	1.13	1.29
12	0.63	0.94	1.25	1.57	1.88	2.20	2.51
15	1.31	1.96	2.61	3.27	3.92	4.57	5.22
22	4.46	6.70	8.93	11.16	13.39	15.62	17.86

Note: Max. heat load values presented in tables 3 & 4 are limited by a maximum pressure drop of 350 Pa/m and a maximum fluid velocity of 1 m/s (CIBSE recommendation).

Section 2:
Room Radiator Sizing

Notes

[8] If you are not sure, proceed with "No" and carry out the steps for upsizing room radiator(s).

[9] If the existing heating system was not operating as designed (i.e. not providing sufficient heat), this step may not be necessary.

[10] MWAT (ΔT) refers to the temperature difference between the water circulating in the radiator and the room's design temperature. For example, if the water entering the radiator is 75°C and the water returning is 65°C, the mean radiator temperature would be 70°C. By subtracting the room design temperature of 20°C from the mean radiator temperature of 70°C, the MWAT ΔT value would be 50°C.

[11] The existing radiator(s) rated output, at MWAT = 50°C (ΔT), can be obtained from the radiator manufacture.

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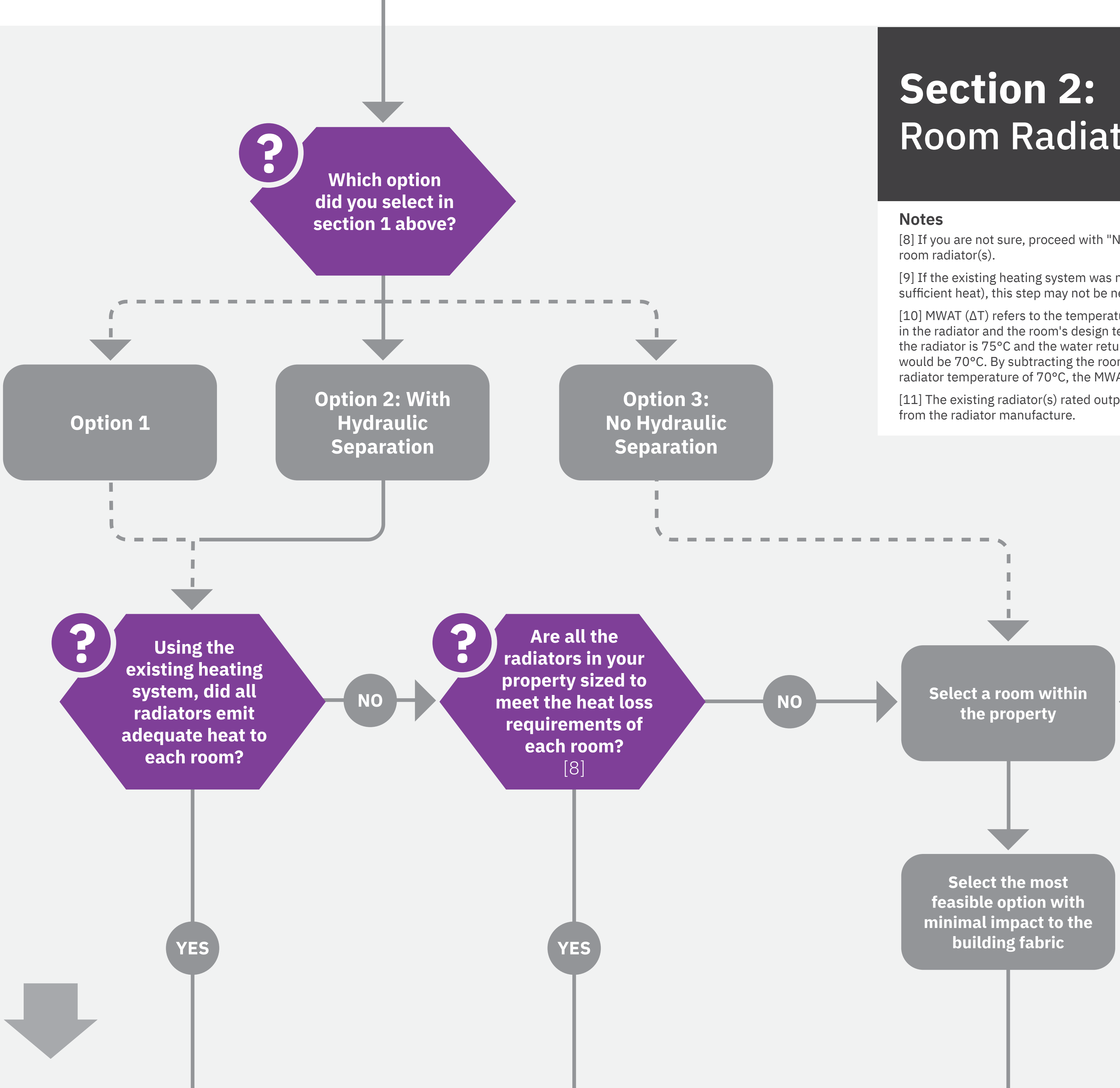

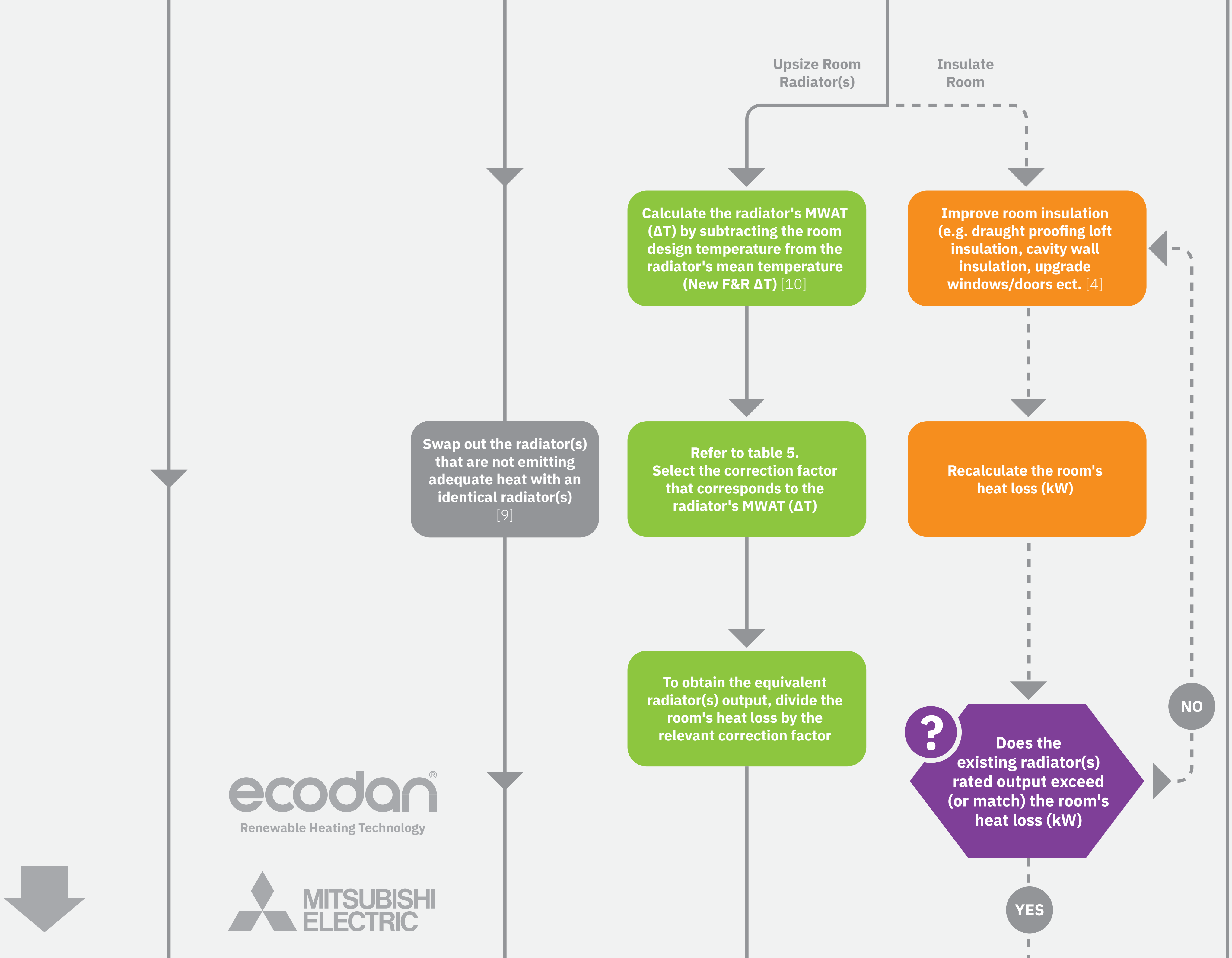

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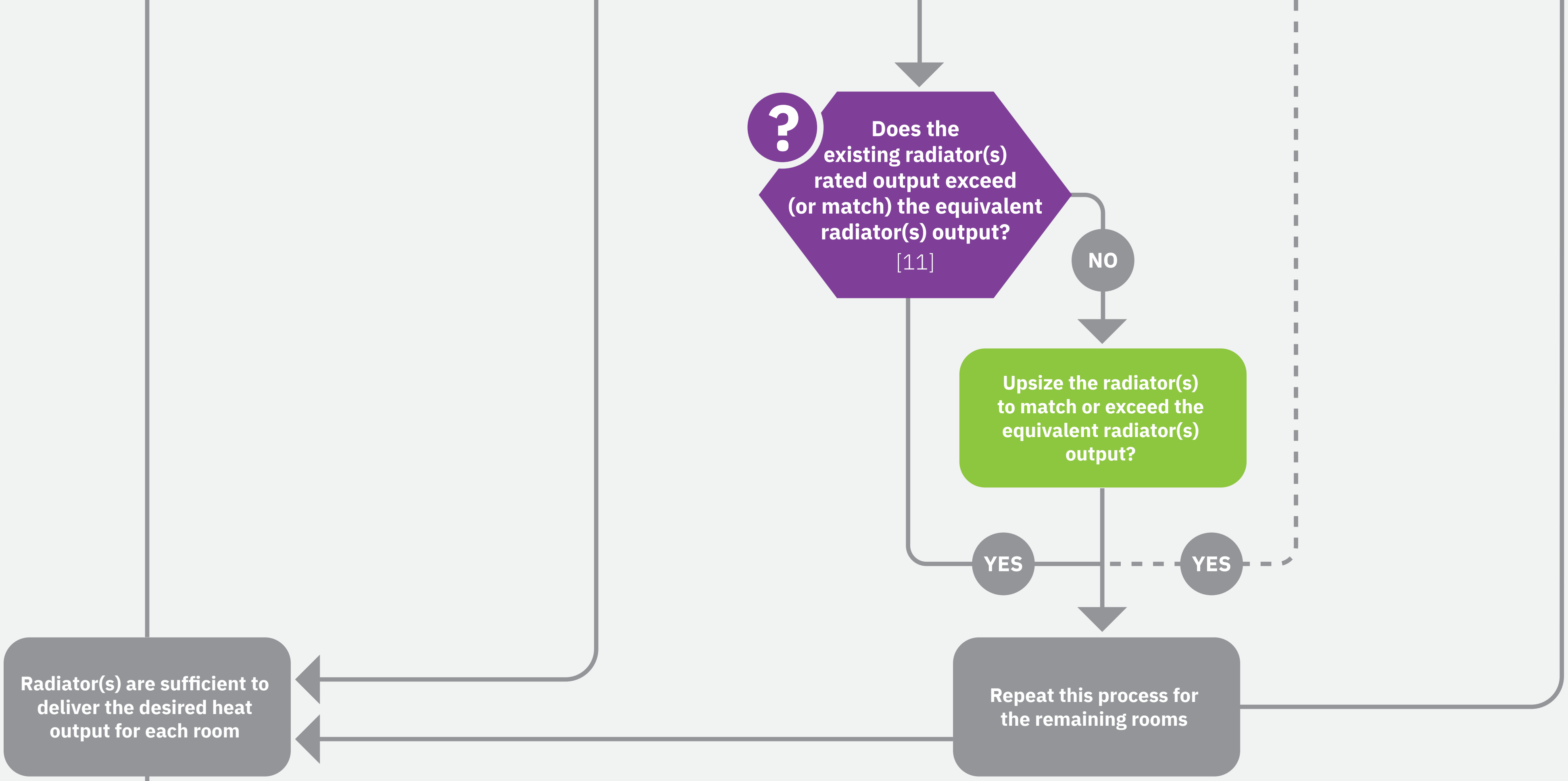

Table 5: MWAT (ΔT) correction factor for radiators

ΔT (°C)	Correction Factor	ΔT (°C)	Correction Factor	ΔT (°C)	Correction Factor	ΔT (°C)	Correction Factor
20	0.302	**32**	0.558	**44**	0.846	**55**	1.132
21	0.322	**33**	0.581	**45**	0.871	**56**	1.159
22	0.342	**34**	0.604	**46**	0.897	**57**	1.186
23	0.363	**35**	0.627	**47**	0.922	**58**	1.213
24	0.383	**36**	0.651	**48**	0.948	**59**	1.241
25	0.404	**37**	0.675	**49**	0.974	**60**	1.268
26	0.426	**38**	0.699	**50**	1	**61**	1.296
27	0.447	**39**	0.723	**51**	1.026	**62**	1.324
28	0.469	**40**	0.747	**52**	1.052	**63**	1.352
29	0.491	**41**	0.771	**53**	1.079	**64**	1.38
30	0.513	**42**	0.796	**54**	1.105	**65**	1.408
31	0.535	**43**	0.821	**54**	1.105		

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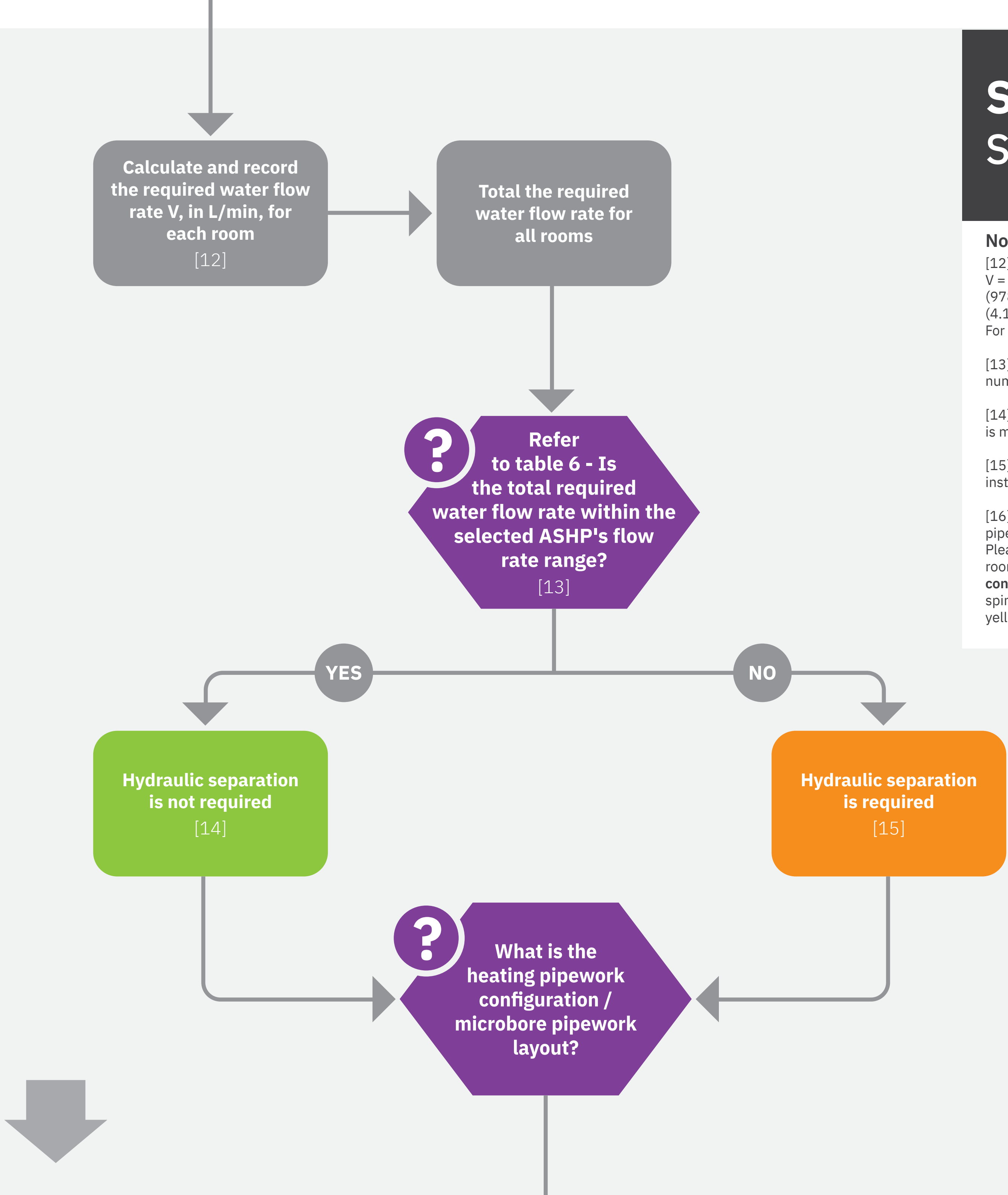
Section 3: Section by Section Pipework Sizing



Notes

[12] To calculate the room's flow rate use the following equation:
V = (Q/(p*Cp*ΔT))*60000, Where Q is the room heat loss (kW), p is the density (978kg/m³), V is the volumetric flow rate (L/min), Cp is the specific heat capacity (4.18kJ/kgK), and ΔT is the new secondary circuit F&R temperature differential (°C). For example, if Q is 2kW and ΔT is 15°, then V = (2/(978*4.18*15)*60000 = 1.96 L/min.

[13] If units were cascaded, then the flow rate range must be multiplied by the number of units cascaded.

[14] If option 2 'with hydraulic separation' was selected, then hydraulic separation is mandatory, Otherwise, proceed to the next step - See footnote [2] for more info.

[15] If option 1 or 3 were selected, hydraulic separation will now need to be installed. Otherwise proceed to the next step - See footnote [2] for more info.

[16] **For manifold pipework configuration**, see figure 1 as an example. Main pipework is highlighted red and pipework before manifold is highlighted blue. Please note that the pipework after manifold (highlighted yellow) refers to the room pipework sized in section 1 of the flow chart. **For flow and return pipework configuration**, see figure 2 as an example. Main pipework is highlighted red and spine pipework is highlighted blue. Please note that the room pipework (highlighted yellow) refers to the room pipework sized in section 1 of the flowchart.

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Refer to figure 1 - Manifold pipework configuration

Refer to figure 2 - Flow and return pipework configuration

Step 5: Determine and record the pipe diameter for the **main pipework**, and the pipework before manifold or the **spine pipework** within the space heating circuit [16]

Step 6: Using the pipe diameters found in step 5, locate and record the max. allowable water flow rate across the pipework by referring to table 7 (copper) or table 8 (plastic)

Step 7:
Total the water flow rates for all the rooms **after the manifold** (i.e. all pipework coming out of that manifold)

Step 7:
Total the water flow rates for all the **room pipework(s)** connected to the **spine pipework** (i.e. all pipework teed off that spine pipework)

? Does the max. allowable flow rate of the pipework before manifold exceed (or match) the total flow rate of the pipework(s) after that manifold?

NO → Refer to table 7/8 - Upsize the pipework before manifold ensuring it exceeds (or matches) the total flow rate of the pipework(s) after that manifold

YES

? Does the max. allowable flow rate of the spine pipework exceed (or match) the total flow rate of the room pipework(s) connected to that spine?

NO → Refer to table 7/8 - Upsize the spine pipework ensuring it exceeds (or matches) the total flow rate of the room pipework(s) to the spine

YES

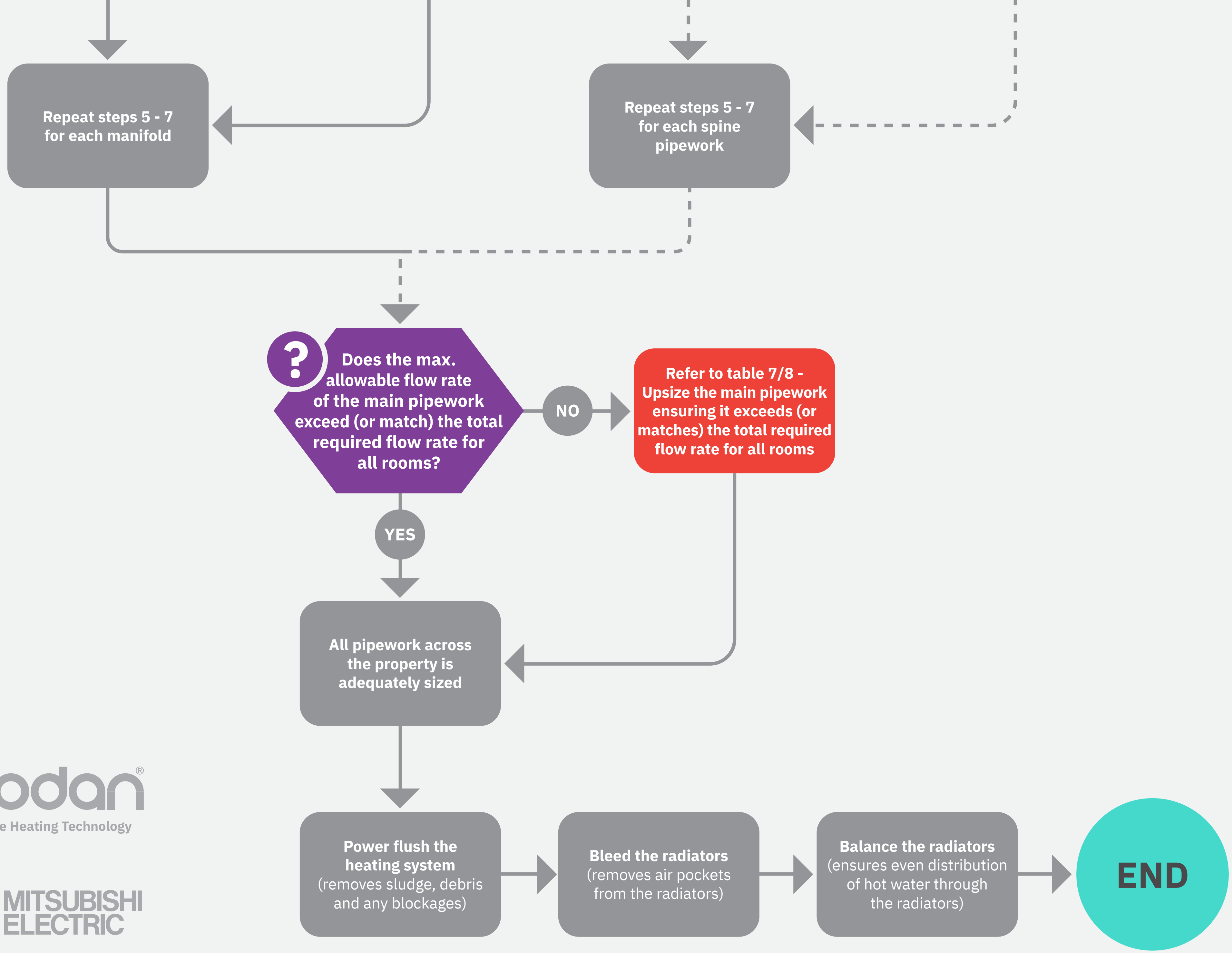

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Table 6: Water flow rate range for Ecodan R290 ASHPs.

	PUZ-WZ50VAA (5kW)	PUZ-WZ60VAA (6kW)	PUZ-WZ80VAA (8kW)
Flow Rate Range (L/min)	6.5 - 14.3	6.5 - 17.2	6.5 - 22.9

Table 7: Max. allowable water flow rate across different **copper** pipe diameters.

Pipe Diameter (mm)	Water Flow Rate, V (L/min)
6	0.31
8	0.81
10	1.64
12	2.89
15	5.33
22	15.59

Table 8: Max. allowable water flow rate across different **plastic** pipe diameters.

Pipe Diameter (mm)	Water Flow Rate, V (L/min)
6	0.27
8	0.75
10	0.94
12	1.84
15	3.83
22	13.08

Note: Max. allowable water flow rate values presented in tables 7 & 8 are limited by a maximum pressure drop of 350 Pa/m and a maximum fluid velocity of 1 m/s (CIBSE recommendation).

Figure 1: Manifold pipework configuration - space heating circuit

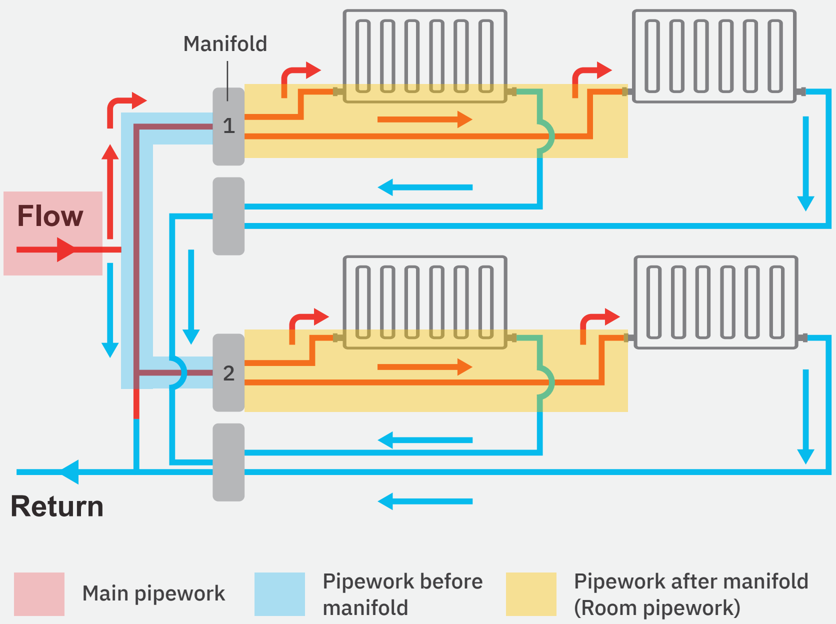
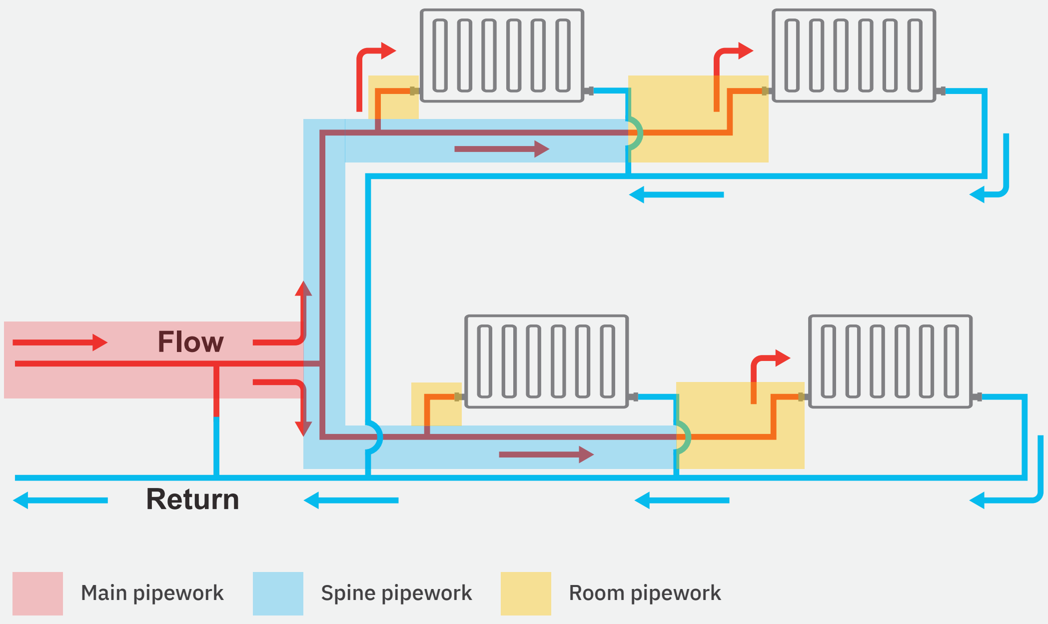


Figure 2: Flow and return pipework configuration - space heating circuit



Note: The figures above illustrate examples of heating pipework configurations. Each property may have slight variations in the pipework setup.

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Telephone: **01707 282880**
email: **heating@meuk.mee.com**
ecodan.co.uk

@Ecodanheating
Mitsubishi Electric Heating UK
mitsubishi_electric_heating_uk
MitsubishiElectricHeatingUK
Mitsubishi Electric Heating UK
BLOG thehub.mitsubishielectric.co.uk

UNITED KINGDOM Mitsubishi Electric Europe Living Environment Systems Division, Travellers Lane, Hatfield, Hertfordshire, AL10 8XB, England. Telephone: 01707 282880
IRELAND Mitsubishi Electric Europe, Westgate Business Park, Ballymount, Dublin 24, Ireland. Telephone: (01) 419 8800 International code: (003531)

Note: The fuse rating is for guidance only and please refer to the relevant databook for detailed specification. It is the responsibility of a qualified electrician/electrical engineer to select the correct cable size and fuse rating based on current regulation and site specific conditions. Mitsubishi Electric's air conditioning equipment and heat pump systems contain a fluorinated greenhouse gas, R410A (GWP:2088), R290 (GWP:3), R32 (GWP:675), R407C (GWP:1774), R134a (GWP:1430), R513A (GWP:631), R454B (GWP:466), R454C (GWP:148), R1234ze (GWP:7) or R1234yf (GWP:4). *These GWP values are based on Regulation (EU) No 517/2014 from IPCC 4th edition. In case of Regulation (EU) No.626/2011 from IPCC 3rd edition, these are as follows. R410A (GWP:1975), R32 (GWP:550), R407C (GWP:1650) or R134a (GWP:1300).

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