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# An overview of air-to-air heating

Green Heat Installer  
Engagement Programme

25 April 2024



# Presenters

Rachel Comrie	Green Heat Installer Engagement Assistant Programme Manager, <b>Energy Saving Trust</b>	Presenter, Q&A Panel
Stuart Hawthorn	Area Sales Manager, Electrified Solutions, <b>Bosch</b>	Presenter, Q&A Panel
Mira Mutkova	Heating Design and Specification Engineer, <b>Bosch</b>	Presenter, Q&A Panel

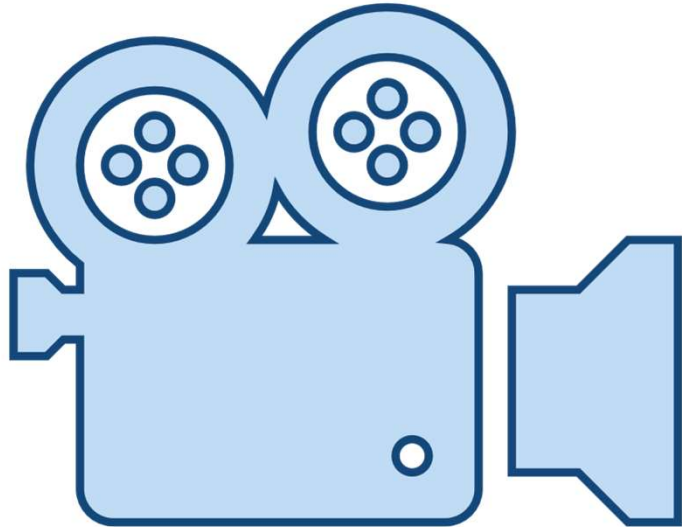
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Please complete this if you can so we can continue to improve the webinars we offer.

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# The Scottish Green Heat transition

Green Heat Installer  
Engagement Programme

Rachel Comrie

25 04 24



# Green Heat Installer Engagement Programme



## Resources hub

Support hub for small businesses working on energy efficiency, heating systems and micro generation. Find research, case studies and online tools to...



## Skills, funding and certification

Discover the certification requirements as an installer or assessor looking to carry out work under various schemes.



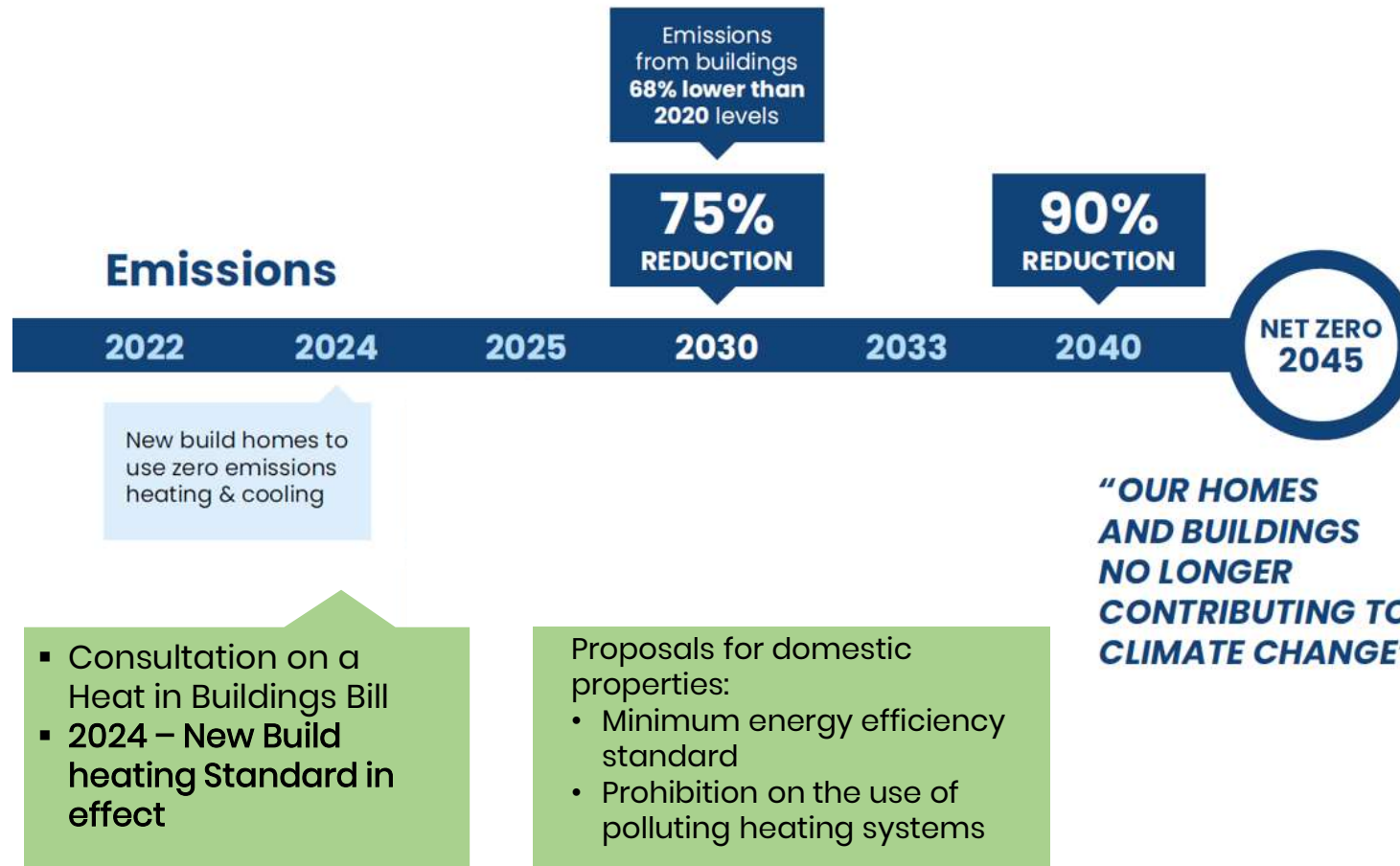
## Green heat installer events

We organise networking events, webinars, workshops and information sessions. All free of charge. Find out more about our upcoming sessions.



## Funding for your customers

Energy Saving Trust helps consumers access funding to make energy efficiency improvements and renewable energy additions to their property.





# Heat in Buildings Bill

## Domestic properties:

Proposals include setting a "Heat in Buildings Standard, which consists of two main parts:

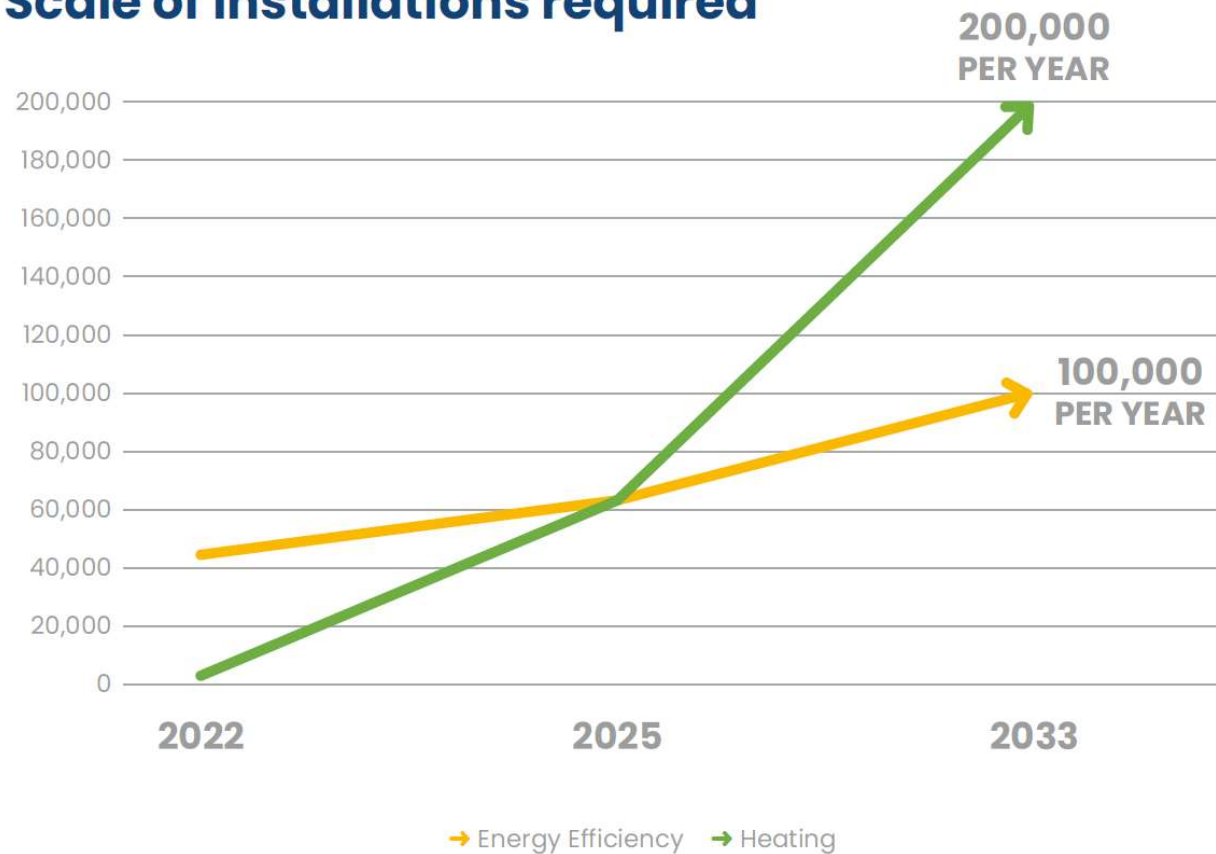
- Prohibition on the use of polluting heating systems after 2045 and progressively at certain 'trigger' points before then
- Make sure that homes meet a reasonable **minimum energy efficiency standard** by the end of 2028 (private rented sector) and end of 2033 (owner-occupiers).

A separate consultation on an equivalent standard for social housing is also underway.



# Domestic energy efficiency installations

## Scale of installations required



# Green Heat Installer Engagement Programme – useful links



Email: [GreenInstallerScotland@est.org.uk](mailto:GreenInstallerScotland@est.org.uk)



LinkedIn Group: [www.linkedin.com/groups/5139242](http://www.linkedin.com/groups/5139242)



Email updates and quarterly newsletter subscription: [bit.ly/2PSatKL](https://bit.ly/2PSatKL)



Website: [energysavingtrust.org.uk/business/energy-efficiency/green-installer](http://energysavingtrust.org.uk/business/energy-efficiency/green-installer)

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Thank you





# **Bosch Air-Conditioning Overview**

Stuart Hawthorn – Area Sales Manager (Electrified Solutions)

Mira Mutkova – Heating Design & Specification Engineer



# Agenda

- Overview of Air to Air Heating
    - Configurations
    - Efficiencies
  - Typical Scenarios
    - Partial Load
    - Full House Load
    - Solar PV integration / hot water
  - Heating and Cooling Design
  - Design Considerations
  - Clearances
  - Planning
  - Electrical Considerations
- Q&A

# Heat pump variations

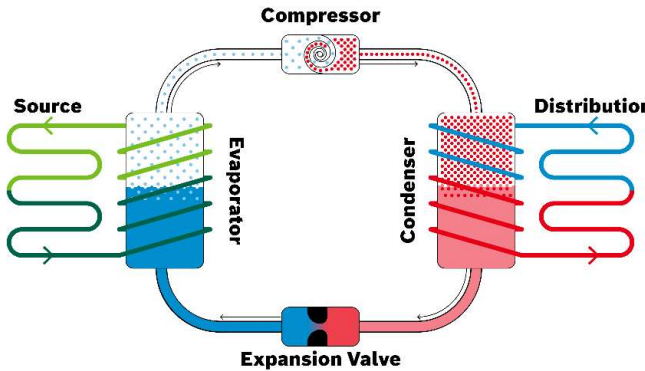
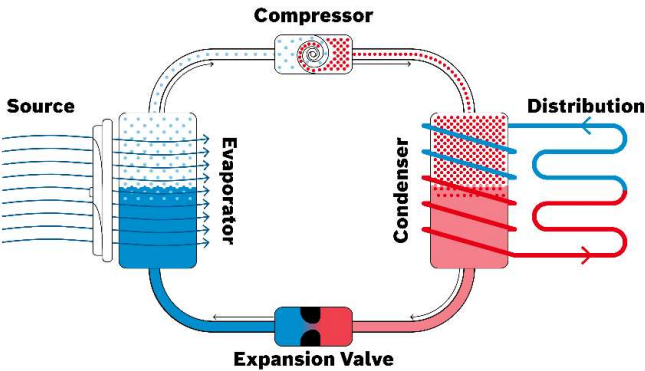
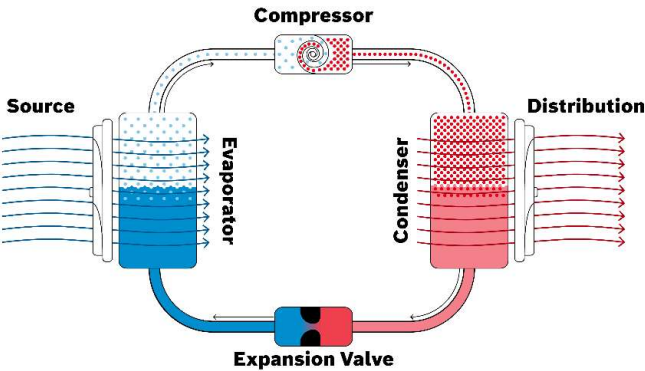
## Heat pump mediums

Heat pumps are often described by their input and output mediums – theory is the same.

**Air to Air (A2A)**  
Air outside is used to heat or cool the air inside.

**Air to Water (A2W)**  
Air outside is used to heat water in a central heating system.

**Ground to Water (G2W)**  
Heat in the ground is used to heat water in a central heating system.



# Bosch Air to Air Heat Pumps

## Brief Overview – Single Split

Air Conditioning or Air to Air Heat Pump?

Refrigerant System (no water)

Requires FGAS Qualification

Heating and Cooling

Easy Install / Minimal Disruption

Dehumidifier

Air Purifying Filter

Instant Heat

Just needs a power supply

Outdoor unit flexibility



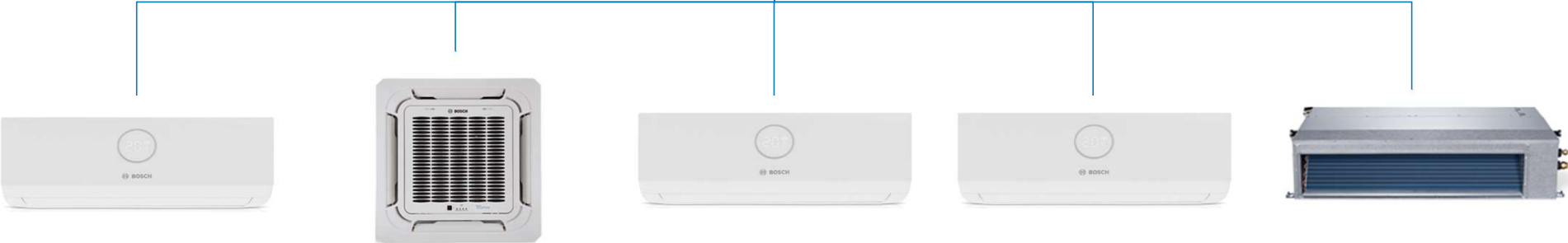


# Bosch Air Conditioning

## Multi Split



Up to 12kw  
Outdoor  
Up to 5 Indoor

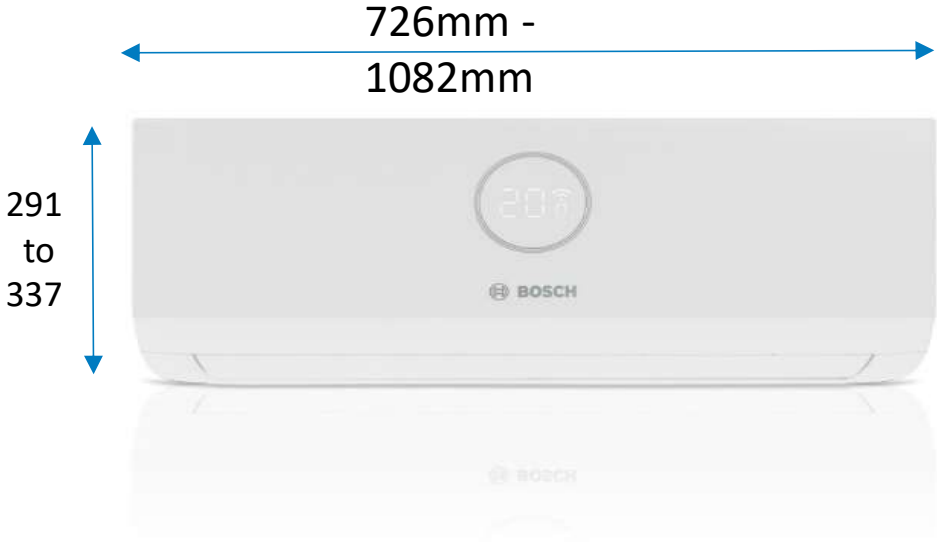


Cassette

Duct

# Bosch Air Conditioning Range

## Wall Mounted Range



Directional Airflow To Suit User

Wall Mounted Unit Only.

Available in:

- ▶ 2 Kw
- ▶ 2.6 Kw
- ▶ 3.5 Kw
- ▶ 5.3 Kw
- ▶ 7 Kw

Comes with wireless controller



# Efficiency

## SCOP and SEER

- ▶ SEER.

- ▶ Seasonal Energy Efficiency Ratio value in cooling
- ▶ Typically ~7.0 or 700%

- ▶ SCOP.

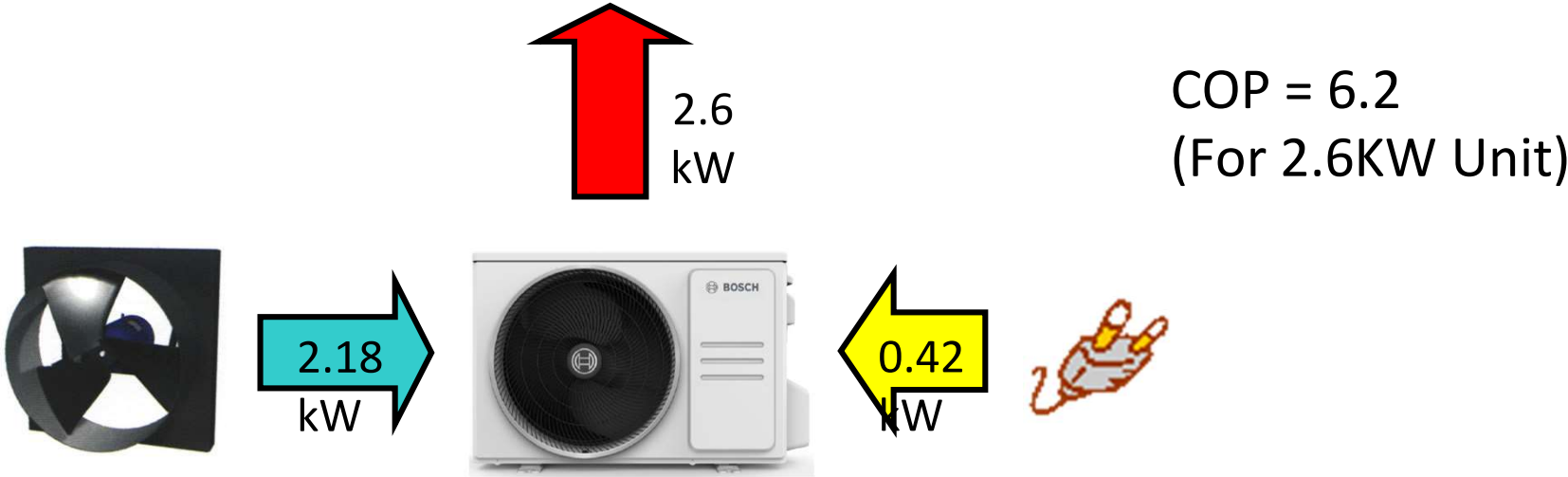
- ▶ Seasonal Coefficient of Performance value in heating
- ▶ Typically above 4.0 or 400%



# Efficiency

## Effect of Additional Cooling Loads

- ▶ Efficiency of **Cooling** based on the following extreme temperatures
  - ▶ Indoor Temp 27 Deg (Dry Bulb)
  - ▶ Outdoor Temp 35 Deg (Dry Bulb)



# Efficiency

## Heating Compared to A2W

SCOP of 4.0 comparable with top performing A2W heat pumps at 45 degree flow temperature.

### **BUT**

No parasitic losses – eg additional pumps, controls etc

Running times tend to be shorter / instant heat

Install and Design can cause massive variations (+ and -) in A2W efficiencies

User behaviour can have a big influence on A2W efficiencies

Bosch Air Con standby consumption on single air con split <1w



# Typical Scenarios for Air to Air Heat Pump

## Challenges that Air to Air can Help Overcome

- Houses / flats with no existing wet central heating system
- Less well insulated properties where low temperature heating is a challenge
- Properties where cost and disruption are a hurdle for Air to Water systems
  - Microbore pipework
  - Challenges with radiator sizing (higher temp reduces efficiency)
  - No space for hot water cylinder
  - Helps combat humidity and mould issues

Overheating is also a challenge in many properties and will get worse – sometimes this may be the catalyst for change and the benefits of low carbon heating come with it...

**BUT** Air to Air Systems are not typically designed to cover hot water demand (more on that later)

Thermal Comfort effect of hot radiators is lost

## Partial Load Scenarios – Single Split Units



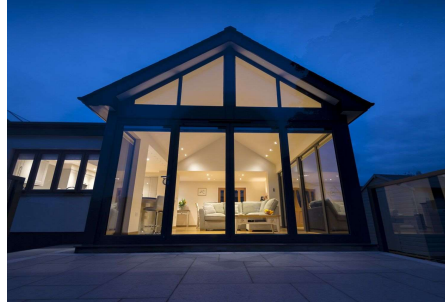
Single Split units can offer a low cost, minimal disruption way to deal with problem spaces.

Perfect for conservatories, garden offices, extensions and open plan living areas.

An easy introduction to heat pump life!



## Partial Load Scenarios – Multi Split Units



Multi split units can offer an energy efficient solution when people aren't ready to completely change their heating system.

The comfort of climate control can be attractive while greatly reducing demand on the existing heating appliance.

In many houses just having units in living areas, master bedroom and hallway can make a big difference to bills and carbon footprint with minimal disruption. Benefits to air quality and comfort in master bedroom also.

# Full Home Heating Solution

- Up to 12kw Heating from 5 indoor units
- May require an element of 'free air movement' through undercut doors.
- Full 'Climate Control' solution
- Air purification and dehumidifying
- Still require natural or forced ventilation.

No hot water



# Solar PV and Air Conditioning

- Air to Air systems and Solar PV are perfect partners
- Additional cooling load minimised, solar PV maximised
- Solar PV also contributes to heating
- Solar PV can be used for hot water generation in summer



# Options For Meeting Hot Water Demand

- Some A2A can provide DHW but generally only 1 bedroom scenarios (90 – 120l)
- Existing combi boiler could be retained if no space for hot water cylinder
- If hot water cylinder can be installed then consider the following:
  - Solar Thermal can be utilised to provide 60-70% of DHW free.
  - Solar PV can provide a large portion of hot water through immersion diverter valves
  - Smart Tariffs can be utilised to heat with immersion overnight
  - Standalone heat pump cylinders are available – high capital cost



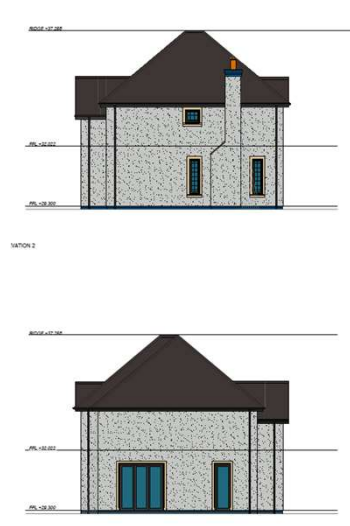
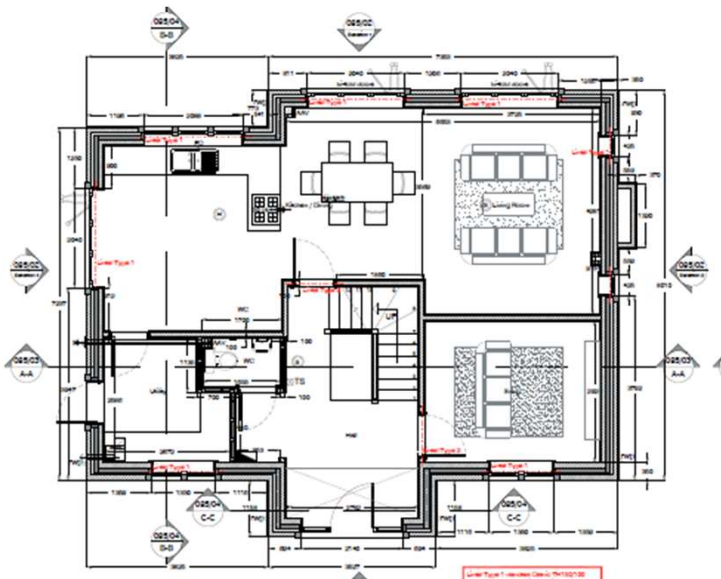
# Design & Install Consideration

# Heating Load Calculations

## Heat Loss Calculating/ Estimation

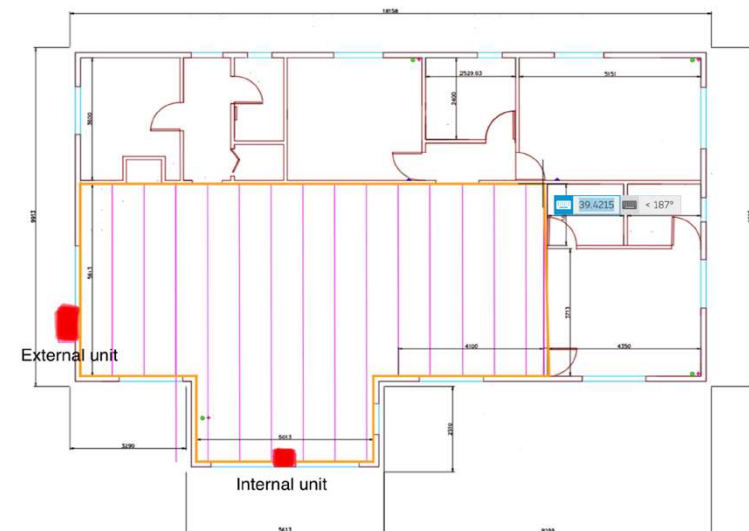
### Room by room heat loss

- Floor plans in CAD format
- Sections and elevations in CAD or PDF
- U-values



### Heat load estimation W/m<sup>2</sup>

- Floor plans or floor area
- Age of the property
- Any improvements and when



# Cooling load Calculation

Based on Rule of Thumb (BSRIA)

1. Room Size			
Please enter room dimensions in metres or feet			
Length	Width	Height	Volume
5	6.25	2.4	75.00 m <sup>3</sup>
0	0	0	0.00 ft <sup>3</sup>
			3,000 Watts A (or)
			.00 Watts B
2. Room Type			
Please select property type		Office	40
If the room is a conservatory, please choose Yes		No	0
Sunny or Shaded Room		Bit of both	0.11
			3330
3. Additional Heat Load			
QTY	Description	Watts	Total
3	Number Of People (Seated, Light Activity)	55	165
0	Number Of People (Sleeping)	35	0
0	Number Of People (Standing up)	150	0
2	Monitor	50	100
3	Desktop Computer	150	450
2	Server	400	800
10	Printer	100	1000
0	Coffee Machine	530	0
0	Television	150	0
0	Fridge	540	0
0	Dishwasher/Washing Machine	150	0
0	Cooker	1,000	0
0	Other, please enter wattage	0	0
3	Please enter lighting wattage	20	60
		Sub Total	2575
		<b>Total</b>	<b>5.91</b> kW

Based on CIBSE Guide A

Country:	United Kingdom	Exterior Temperature °C	27	Design Room Temperature °C	21	Change Exterior Temperature			
Room	Kitchen/Dining/	Area [m <sup>2</sup> ]	31	Volume [m <sup>3</sup> ]	75				
Interior Heat Input								3210	
People									
QTY									
3									
Activity Level	sitting, light activity						Total Watt People	225	
Illumination									
Illumination technique	LED						Total Watt Lighting	310	
Appliances									
Type of Appliance	QTY	Watt							
1. Server	2	800							
2. Desktop computer	3	450							
3. Printer	10	1000							
4. Desktop computer	2	300							
5. Monitor	2	100							
6. Scanner	1	25							
7.		0							
							Total Watt Appliance	2675	
Exterior Heat Input								3265	
Walls (only exterior walls)									
U-Value	or	Year of construction	Component						
0.19		> 2002	Other solid wall constructions over 20 cm wall thickness						
Area Wall (without windows) [m <sup>2</sup> ]								Total Watt Walls	31
27.3									
Solar Radiation									
Orientation Windows									
North									
Area windows [m <sup>2</sup> ]									
14.2									
g-Value	or	Type of glass	Type of Sunblind	Determined g-Value					
0.7		Triple glass with air filling	Exterior Blind (45° position) dark gray	0.13				Total Watt Solar Radiation	3009
Infiltration									
Volume rate flow	Air Exchange Rate							Total Watt Infiltration	225
113	1.5								
<b>Total Cooling Load:</b>								<b>5828</b> Watt	

# Designs and Install Considerations

Units placement: Multi-split system:





# Designs and Install Considerations

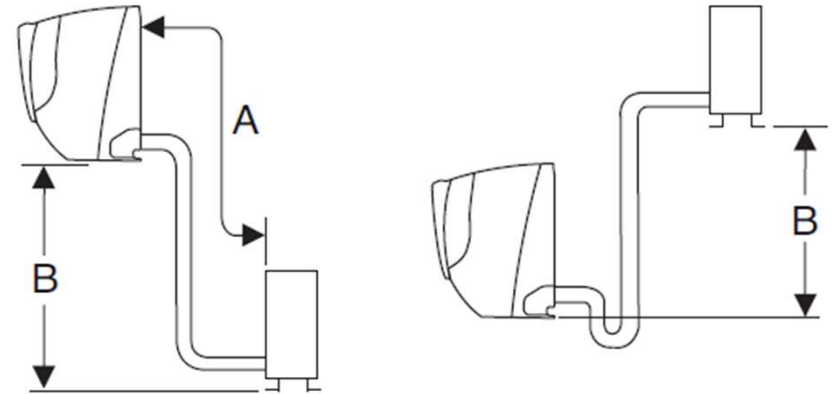
Units placement: Airzone Plenum system:



# Designs and install considerations

## Refrigerant Pipework lengths:

- Minimum pipe length between IU & OU of 3m
- Maximum height between IU & OU (B)
- Maximum length with pre-charged refrigerant (A)
- Maximum length with additional refrigerant
- Additional amount of refrigerant for additional pipework



## Refrigerant consideration :

As AC uses highly flammable refrigerant, special consideration should be taken when specifying Multi-split air conditioning system in small rooms such as: Kitchenettes in Office building, Small office room, bathroom etc.

Maximum refrigeration amount must be checked for rooms as per **BS EN 378-1** using appropriate calculation method.

$$M_{max} = 2.5 \times LFL^{1.25} \times ho \times \sqrt{A}$$

# Designs and Install Considerations

## Condensation pipework:

- Gravity condense drain

Most cost effective way if the IU is on external wall close to a drain.

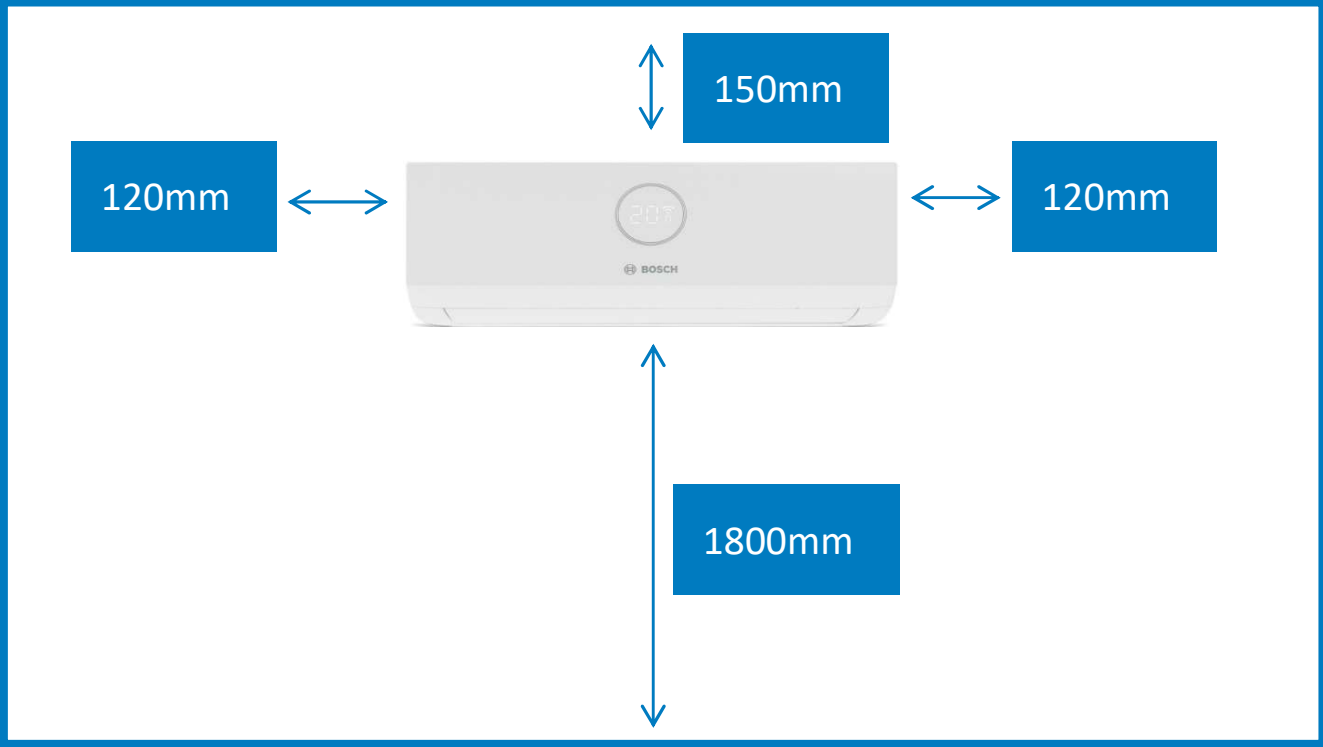
- Pump assisted condense drain

Would be required when the IU is located on internal wall. Depending on the condense pipe route, in-Line or Corner Pump would be required.



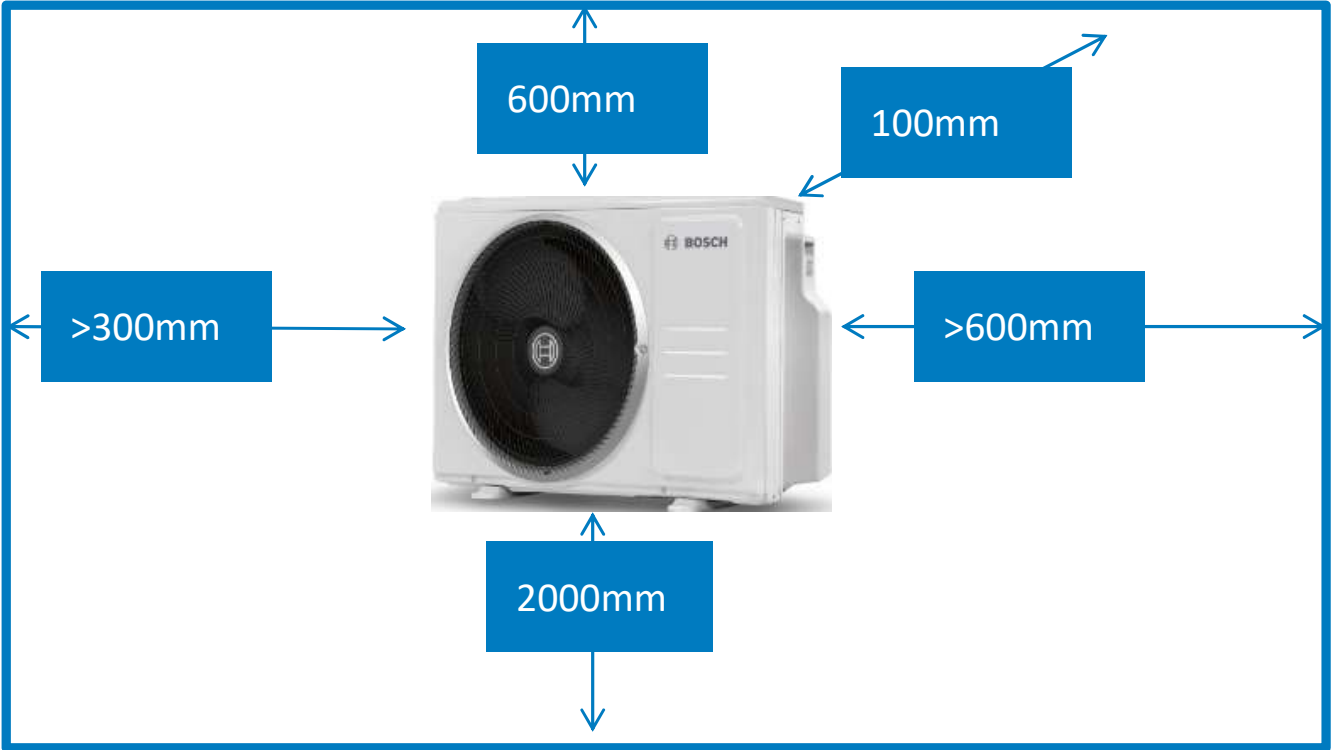
# Design & Install Considerations

## Climate 3000i IDU Clearances



# Design & Install Considerations

## Clearances



# Design & Install Considerations

## Installation Considerations

[https://tube.video.bosch.com/media/Positioning+of+OD+U/0\\_jdgskju3](https://tube.video.bosch.com/media/Positioning+of+OD+U/0_jdgskju3)

- ▶ Do not install the outdoor unit directly next to water or where it is exposed to sea air.
- ▶ The outdoor unit must always be kept free of snow.
- ▶ There must be no disruption caused by exhaust air or operating noise.
- ▶ Air should be able to circulate freely around the outdoor unit, but the appliance must not be exposed to strong wind.
- ▶ Condensate that forms during operation must be able to drain off easily to prevent freezing.
- ▶ Place the outdoor unit on a stable base.

# Design & Install Considerations

## Planning permission

A air conditioning unit is a permitted development, however in some cases planning permission is required.

**EN: ODU >0.6m<sup>3</sup>**

**W: ODU >1m<sup>3</sup>**

**SC: >3m height**

**NI: >2m height**

**Distance to boundary**

England and Scotland <1m

Wales <3m

Local authority guidance

**MCS 020 Noise levels at  
neighbor's property <42db(A)**

**It is the 2<sup>nd</sup> installation of a heat  
pump**

**It is visible from the street or  
installed on a pitched roof**

**A wind turbine is installed on  
the building or within the  
property boundary**

# Design & Install Considerations

## Planning permission

An air conditioning Unit is a permitted development, however in some cases planning permission is required.

- An Area of Outstanding Natural Beauty
- A National Park
- A Conservation Area
- A World Heritage Site
- Listed Buildings

Best practice is to always seek advice from your Local Authority, even if you believe your project to fall under permitted development. If you go ahead with your installation, and it turns out permission was in fact needed, you may well end up having to remove the system in its entirety



# Design & Install Considerations

## Electrical Considerations

- All CL3000, CL5000 M and CL5000L (Up to 12kW) units are single phase; therefore, in most cases DNO would not be required. Exclusion makes where there is already an ASHP or EV charging point installed, in which case DNO should be completed.

- CL5000L 14 & 16kW are 3-phase; therefore, DNO must be complete prior to install and 3-Phase supply provided to the property.



**Thank you**

**Any Questions ?**



You can ask questions by typing them into the questions box of the control panel

## Panellists:

Rachel Comrie

Green Heat Installer  
Engagement Assistant  
Programme Manager, Energy  
Saving Trust

Stuart Hawthorn

Area Sales Manager, Electrified  
Solutions, Bosch

Mira Mutkova

Heating Design and  
Specification Engineer, Bosch



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