



CLADE

LARCH CASCADE HEAT PUMP //
150KW, 250KW & 350KW //

Aug 24 //



THE LARCH CASCADE HEAT PUMP //

What is a Larch heat pump?

The Clade Larch Cascade heat pump is actually two heat pumps working together to produce temperatures that can directly replace a boiler, for example 82°C flow, 71°C return.

Unlike other manufacturers Clade's Larch is not just a combination of standard products that the designer and installer has to somehow make work, rather it is a specifically designed pair of LT and HT heat pumps that work in harmony for maximum efficiency.

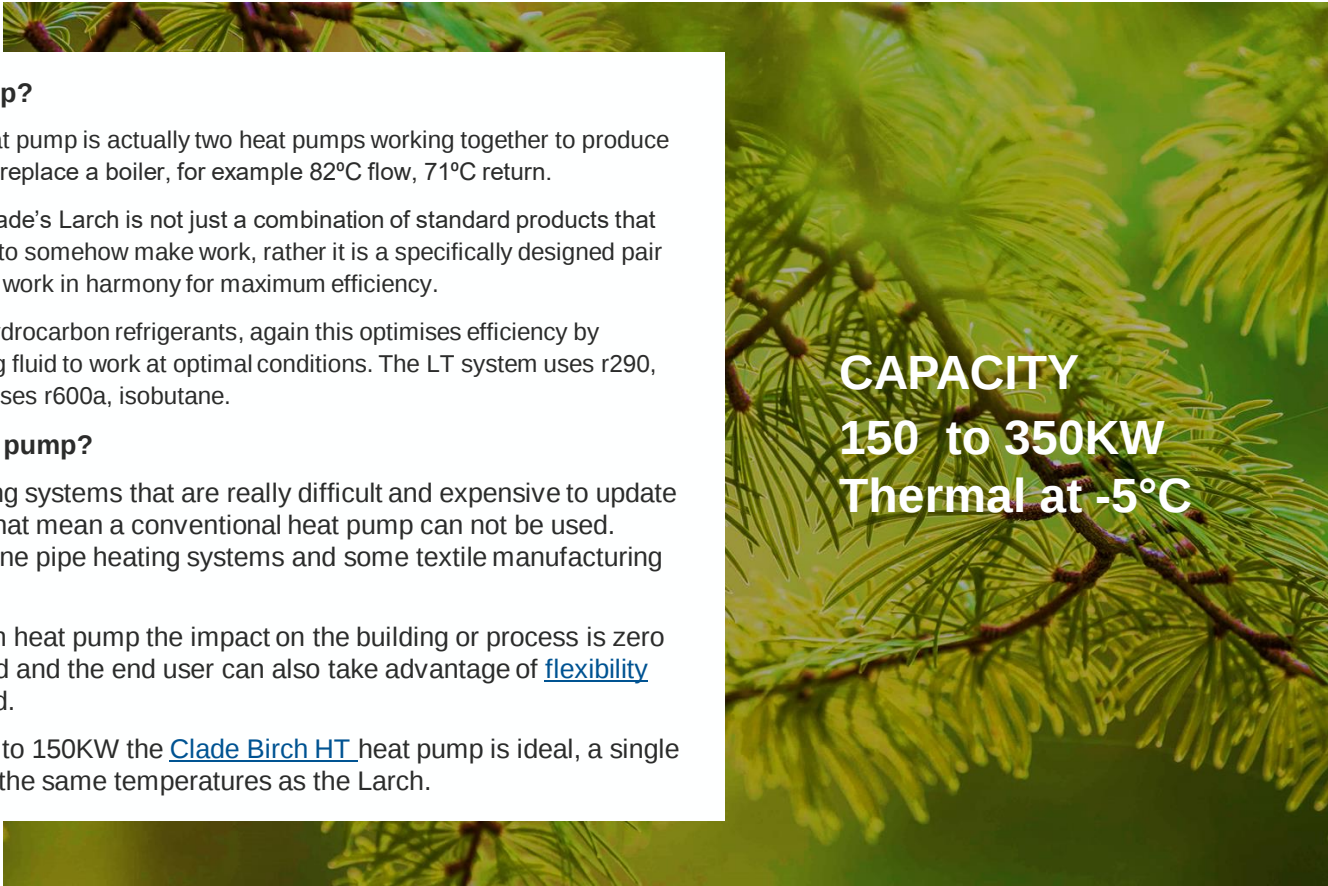
Clade use a combination of hydrocarbon refrigerants, again this optimises efficiency by allowing each different working fluid to work at optimal conditions. The LT system uses r290, propane, and the HT system uses r600a, isobutane.

Why specify a Larch heat pump?

Some buildings have heating systems that are really difficult and expensive to update or have critical processes that mean a conventional heat pump can not be used. Examples include historic one pipe heating systems and some textile manufacturing processes.

By specifying a Clade Larch heat pump the impact on the building or process is zero yet the heat is decarbonised and the end user can also take advantage of [flexibility incentives](#) on the power grid.

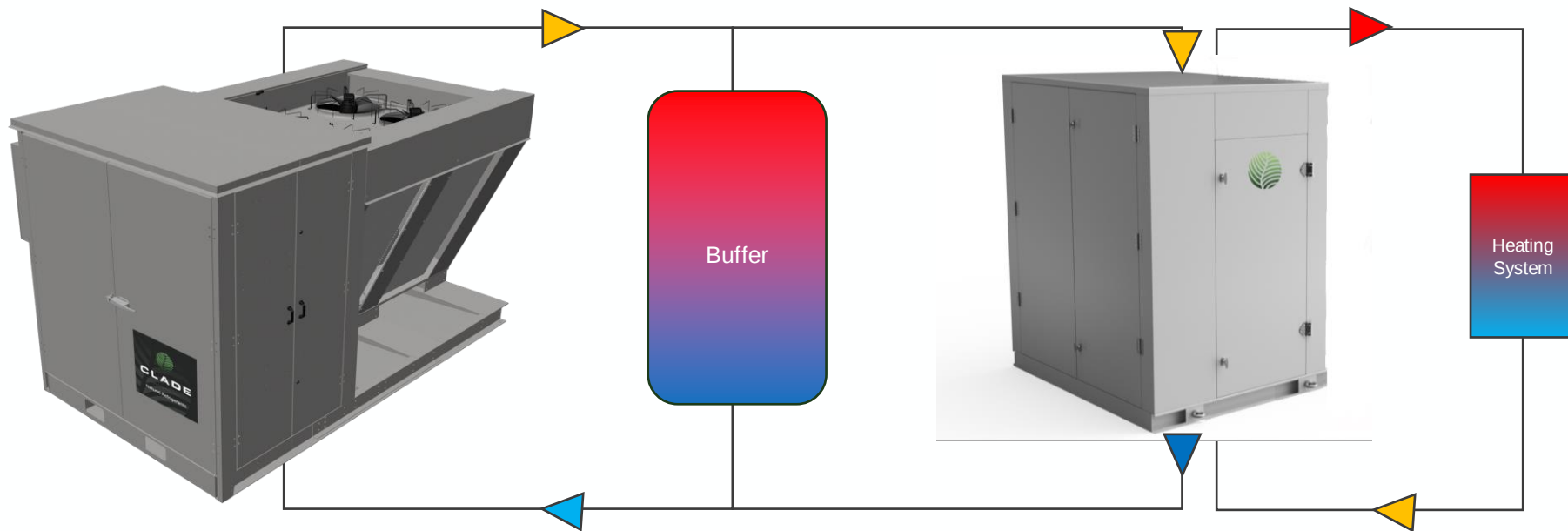
For smaller applications up to 150KW the [Clade Birch HT](#) heat pump is ideal, a single stage heat pump that does the same temperatures as the Larch.



CAPACITY
150 to 350KW
Thermal at -5°C



THE LARCH CASCADE //



Operational parameters

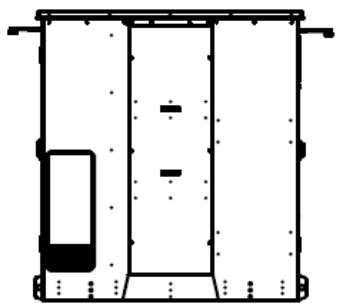
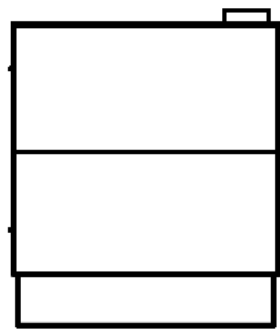
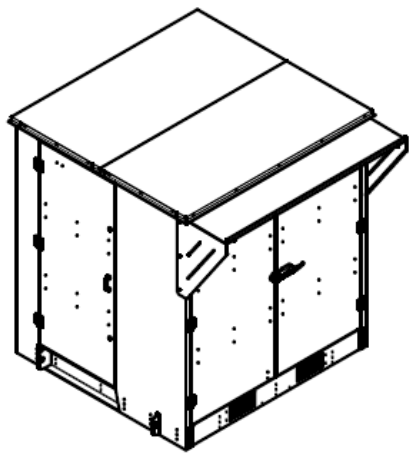
- Max flow temperature – 80C
- Max return temperature – 70C
- Max turndown ratio – 50%

Scope of supply

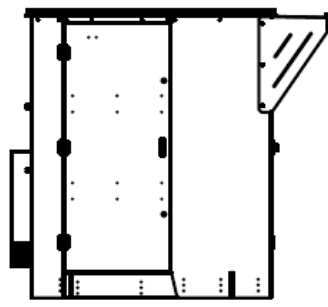
- Low temp r290 ASHP
- High temp r600a WSHP



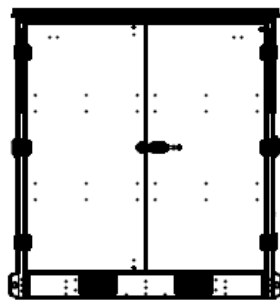
150KW DIMENSIONAL DRAWINGS HT WSHP //



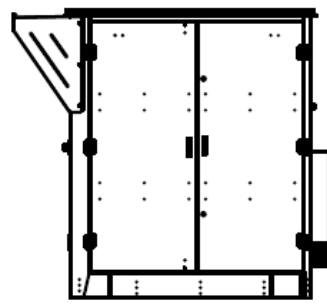
Back View



1879mm



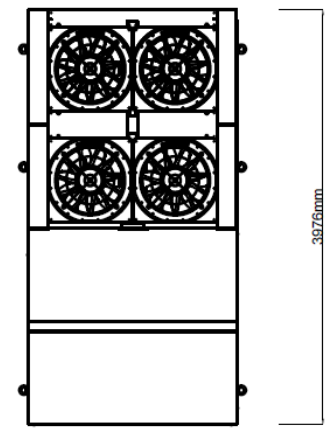
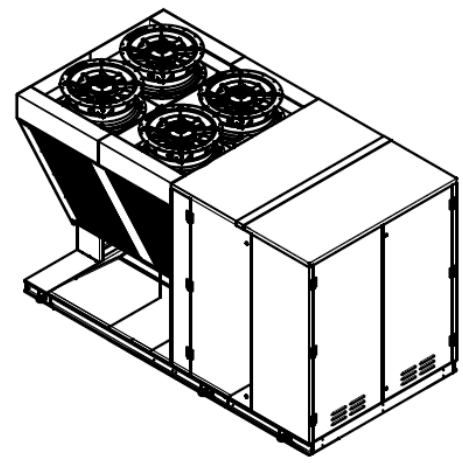
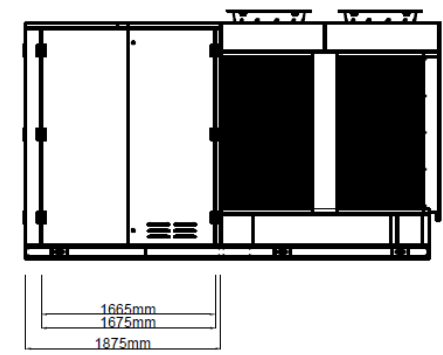
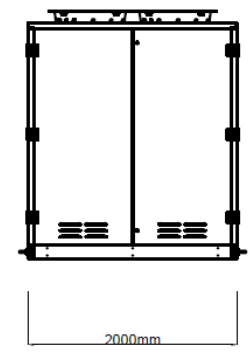
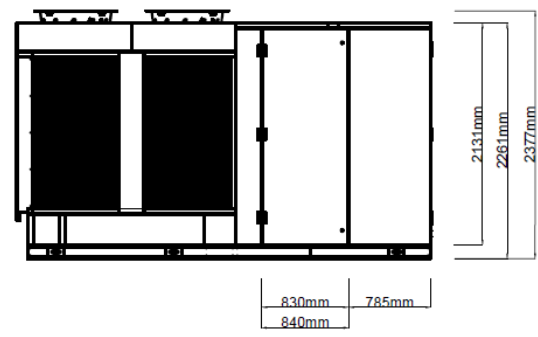
2004mm



2252mm



150KW DIMENSIONAL DRAWINGS LT ASHP //

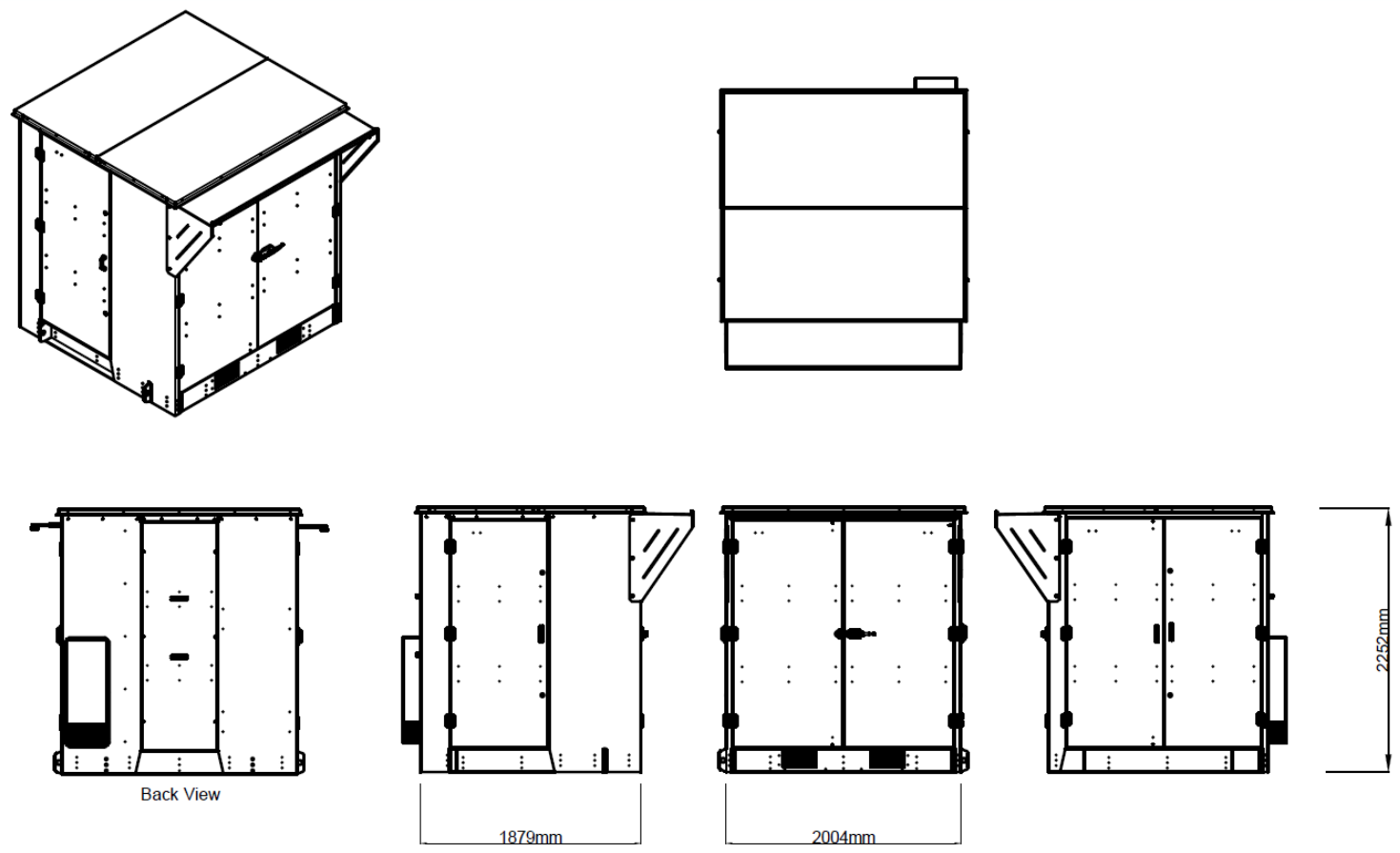




150KW TECHNICAL //

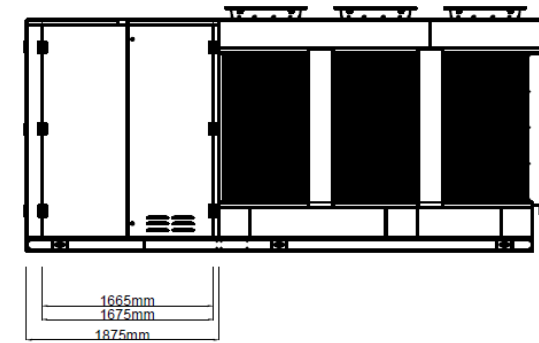
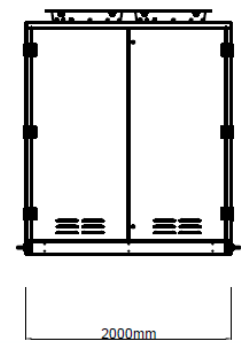
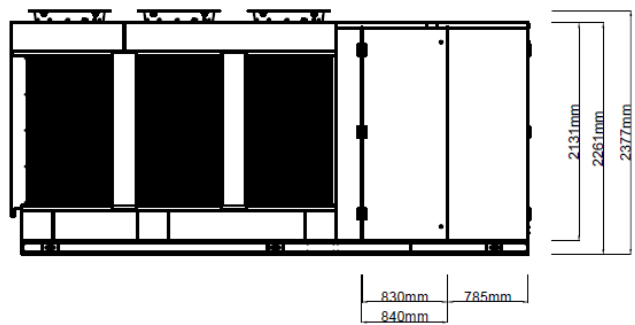
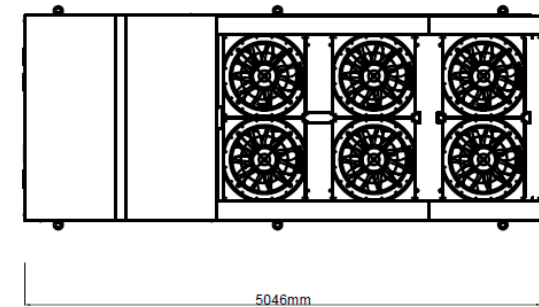
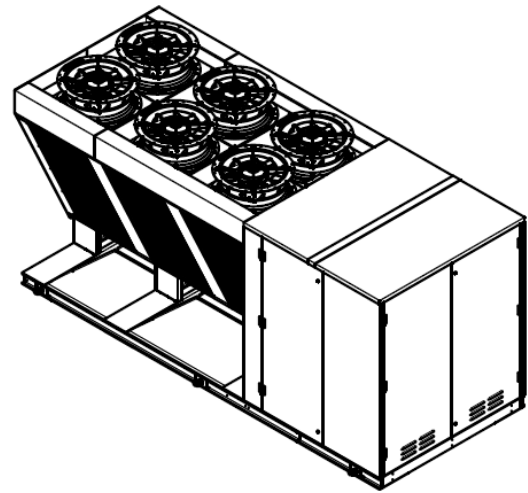
Clade Larch 150kW		
ASHP R290		
Nominal conditions: Water side		Return 37c to 45c Flow temperature <8°C
Nominal conditions: Propane Side		Ambient air temperature -3°C (85% RH) and -10°C evaporation
Compressor Manufacturer		Dorin
Compressor Heating Qty	Pcs.	2
Total Power	kW	51.96
Total Amps	A	84.64
Variable speed drive (VSD)	Pcs.	2
Refrigerant charge (R290)	kg	7.5
Electrical supply	-	3ph~ 400V 50 HZ
Unit Weight (empty)	kg	3,153
Unit Weight (operational)	kg	3,197
Water Volume	L	37
Sound Power	dB(A)	77.2
Sound Pressure 1m	dB(A)	56.8
Sound Pressure 10m	dB(A)	44.6
Connections waterside flow		67mm
Connections waterside Return		67mm
Communication protocol	-	BACNET
IP-Class	-	IP54
Evaporators Type		V Block
No. evaporators	Pcs.	4
Fin Material	-	AL/MG
Defrost Type	-	Hot Gas R290
Defrost design/condition	-	> +6c ambient Off Cycle / < +6c ambient Cool Gas
Fan regulation	-	0-10v
Colour	-	Goosewing Grey
WSHP R600a		
Nominal conditions: Water side		Return 70c to 80c Flow temperature
Compressor Manufacturer		Dorin
Compressor Heating Qty	Pcs.	2
Total Power	kW	50.68
Total Amps	A	83.4
Variable speed drive (VSD)	Pcs.	2
Refrigerant charge (R600)	kg	8
Electrical supply	-	3ph~ 400V 50 HZ
Unit Weight (empty)	kg	2,034
Unit Weight (operational)	kg	2,106
Water Volume	L	64
Sound Power	dB(A)	75.2
Sound Pressure 1m	dB(A)	54.8
Sound Pressure 10m	dB(A)	42.6
Connections waterside flow		67mm
Connections waterside Return		67mm
Communication protocol	-	BACNET
IP-Class	-	IP54
Fin Material	-	AL/MG
Colour	-	Goosewing Grey

250KW DIMENSIONAL DRAWINGS HT WSHP //





250KW DIMENSIONAL DRAWINGS LT ASHP //



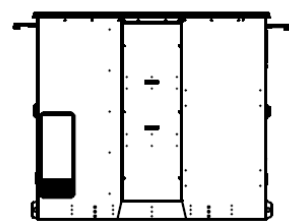
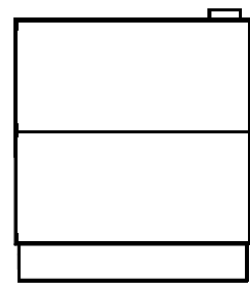
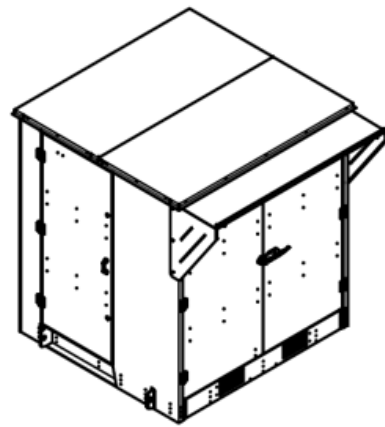


250KW TECHNICAL //

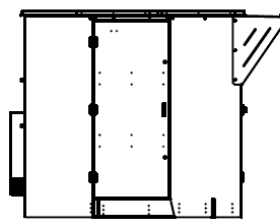
Clade Larch 250kW		
ASHP R290		
Nominal conditions: Water side		Return 37c to 45c Flow temperature <8°C
Nominal conditions: Propane Side		Ambient air temperature -3°C (85% RH) and -10°C evaporation
Compressor Manufacturer		Dorin
Compressor Heating Qty	Pcs.	2
Total Power	kW	73.51
Total Amps	A	119.95
Variable speed drive (VSD)	Pcs.	2
Refrigerant charge (R290)	kg	13
Electrical supply	-	3ph ~ 400V 50 HZ
Unit Weight (empty)	kg	3,863
Unit Weight (operational)	kg	3,936
Water Volume	L	60
Sound Power	dB(A)	77.9
Sound Pressure 1m	dB(A)	57.5
Sound Pressure 10m	dB(A)	45.3
Connections waterside flow		76mm
Connections waterside Return		76mm
Communication protocol	-	BACNET
IP-Class	-	IP54
Evaporators Type		V Block
No. evaporators	Pcs.	6
Fin Material	-	AL/MG
Defrost Type	-	Hot Gas R290
Defrost design/condition	-	> +6c ambient Off Cycle / < +6c ambient Cool Gas
Fan regulation	-	0-10v
Colour	-	Goosewing Grey
WSHP R600a		
Nominal conditions: Water side		Return 70c to 80c Flow temperature
Compressor Manufacturer		Dorin
Compressor Heating Qty	Pcs.	2
Total Power	kW	66.91
Total Amps	A	110.2
Variable speed drive (VSD)	Pcs.	2
Refrigerant charge (R600)	kg	13
Electrical supply	-	3ph ~ 400V 50 HZ
Unit Weight (empty)	kg	2,368
Unit Weight (operational)	kg	2,479
Water Volume	L	98
Sound Power	dB(A)	75.2
Sound Pressure 1m	dB(A)	54.8
Sound Pressure 10m	dB(A)	42.6
Connections waterside flow		76mm
Connections waterside Return		76mm
Communication protocol	-	BACNET
IP-Class	-	IP54
Fin Material	-	AL/MG
Colour	-	Goosewing Grey



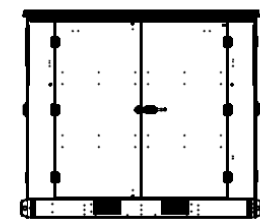
350KW DIMENSIONAL DRAWINGS HT WSHP //



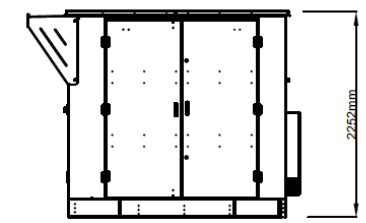
Back View



2379mm



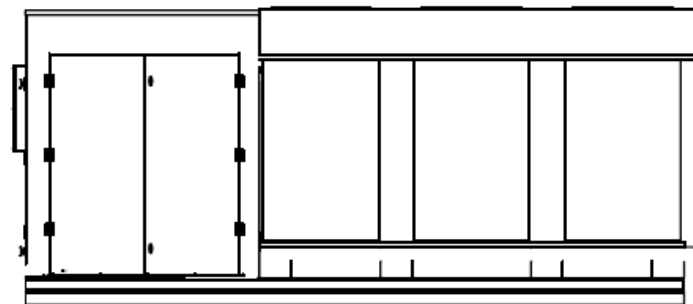
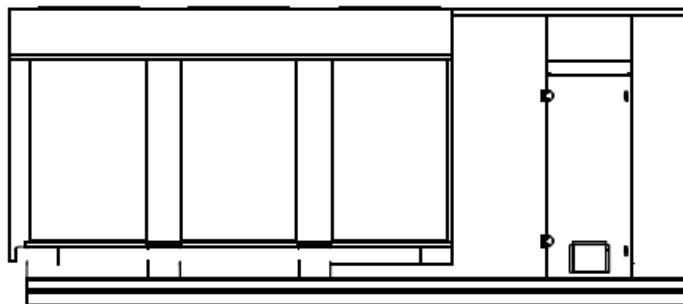
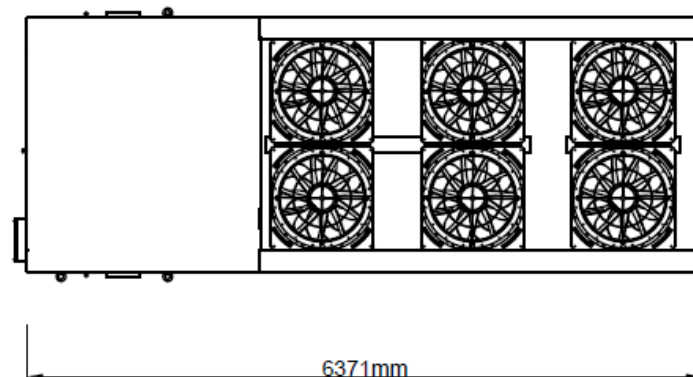
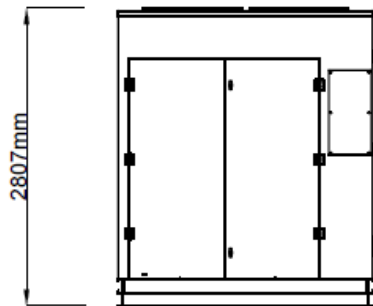
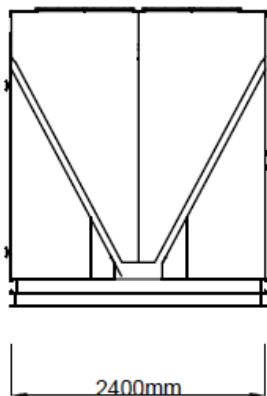
2500mm



2252mm



350KW DIMENSIONAL DRAWINGS LT ASHP //





350KW TECHNICAL //

Clade Larch 350kW		
ASHP R290		
Nominal conditions: Water side		Return 37c to 45c Flow temperature <8°C Ambient air temperature -3°C (85% RH) and -10°C evaporation
Nominal conditions: Propane Side		
Compressor Manufacturer		Dorin
Compressor Heating Qty	Pcs.	2
Total Power	kW	100.51
Total Amps	A	163.86
Variable speed drive (VSD)	Pcs.	2
Refrigerant charge (R290)	kg	17
Electrical supply	-	3ph ~ 400V 50 HZ
Unit Weight (empty)	kg	4,193
Unit Weight (operational)	kg	4,293
Water Volume	L	83
Sound Power	dB(A)	87.6
Sound Pressure 1m	dB(A)	65.3
Sound Pressure 10m	dB(A)	54.4
Connections waterside flow		108mm
Connections waterside Return		108mm
Communication protocol	-	BACNET
IP-Class	-	IP54
Evaporators Type		V Block
No. evaporators	Pcs.	6
Fin Material	-	AL/MG
Defrost Type	-	Hot Gas R290
Defrost design/condition	-	> +6c ambient Off Cycle / < +6c ambient Cool Gas
Fan regulation	-	0-10v
Colour	-	Goosewing Grey
WSHP R600a		
Nominal conditions: Water side		Return 70c to 80c Flow temperature
Compressor Manufacturer		Dorin
Compressor Heating Qty	Pcs.	2
Total Power	kW	107.11
Total Amps	A	176.46
Variable speed drive (VSD)	Pcs.	2
Refrigerant charge (R600)	kg	18
Electrical supply	-	3ph ~ 400V 50 HZ
Unit Weight (empty)	kg	2,618
Unit Weight (operational)	kg	2,774
Water Volume	L	138
Sound Power	dB(A)	75.2
Sound Pressure 1m	dB(A)	54.8
Sound Pressure 10m	dB(A)	42.6
Connections waterside flow		108mm
Connections waterside Return		108mm
Communication protocol	-	BACNET
IP-Class	-	IP54
Fin Material	-	AL/MG
Colour	-	Goosewing Grey



COP & PERFORMANCE DATA //

Larch heat pumps are a two stage system with a low temperature air source supplying a high temperature water source heat pump.

Clade have manufactured specific units which are designed to work in harmony and at the highest possible efficiency.

The actual COP of a heat pump is determined by the heat pump itself (as given below), the ambient conditions and the heating system performance. SCOP can be improved by using weather compensation to lower the flow temperature whenever possible.

Clade Heat Pump Performance Characteristics - v2.0																					
Model name	Nameplate output (kW)	Output Temp (°C)	Return Temp (°C)	SCOP	SPF	-10°C External		-5°C External		0°C External		5°C External		10°C External		15°C External		20°C External		25°C External	
						kW	COP	kW	COP	kW	COP	kW	COP	kW	COP	kW	COP	kW	COP	kW	COP
Larch 350 kW	350	80	70	2.1	2.2	280	1.9	333	2.01	392	2.14	420	2.24	420	2.33	420	2.39	420	2.48	420	2.59
		75	65	2.25	2.3	293	2	346	2.1	407	2.22	420	2.35	420	2.45	420	2.5	420	2.6	420	2.7
		70	60	2.4	2.4	311	2.1	361	2.2	420	2.32	420	2.43	420	2.55	420	2.62	420	2.73	420	2.84
		65	55	2.55	2.5	328	2.2	375	2.3	420	2.43	420	2.55	420	2.66	420	2.75	420	2.85	420	2.95

Clade Heat Pump Performance Characteristics - v2.0																					
Model name	Output (kW)	Output Temp (°C)	Return Temp (°C)	SCOP	SPF	-10°C External		-5°C External		0°C External		5°C External		10°C External		15°C External		20°C External		25°C External	
						kW	COP	kW	COP	kW	COP	kW	COP	kW	COP	kW	COP	kW	COP	kW	COP
Larch 250 kW	250	80	70	2.1	2.2	200	1.9	238	2.01	280	2.14	300	2.24	300	2.33	300	2.39	300	2.48	300	2.59
		75	65	2.25	2.3	209	2	247	2.1	291	2.22	300	2.35	300	2.45	300	2.5	300	2.6	300	2.7
		70	60	2.4	2.4	222	2.1	258	2.2	300	2.32	300	2.43	300	2.55	300	2.62	300	2.73	300	2.84
		65	55	2.55	2.5	234	2.2	268	2.3	300	2.43	300	2.55	300	2.66	300	2.75	300	2.85	300	2.95

Clade Heat Pump Performance Characteristics - v2.0																					
Model name	Output (kW)	Output Temp (°C)	Return Temp (°C)	SCOP	SPF	-10°C External		-5°C External		0°C External		5°C External		10°C External		15°C External		20°C External		25°C External	
						kW	COP	kW	COP	kW	COP	kW	COP	kW	COP	kW	COP	kW	COP	kW	COP
Larch 150 kW	150	80	70	2.1	2.2	120	1.9	143	2.01	168	2.14	180	2.24	180	2.33	180	2.39	180	2.48	180	2.59
		75	65	2.25	2.3	126	2	148	2.1	174	2.22	180	2.35	180	2.45	180	2.5	180	2.6	180	2.7
		70	60	2.4	2.4	133	2.1	155	2.2	180	2.32	180	2.43	180	2.55	180	2.62	180	2.73	180	2.84
		65	55	2.55	2.5	141	2.2	161	2.3	180	2.43	180	2.55	180	2.66	180	2.75	180	2.85	180	2.95



LARCH SYSTEM P&ID //

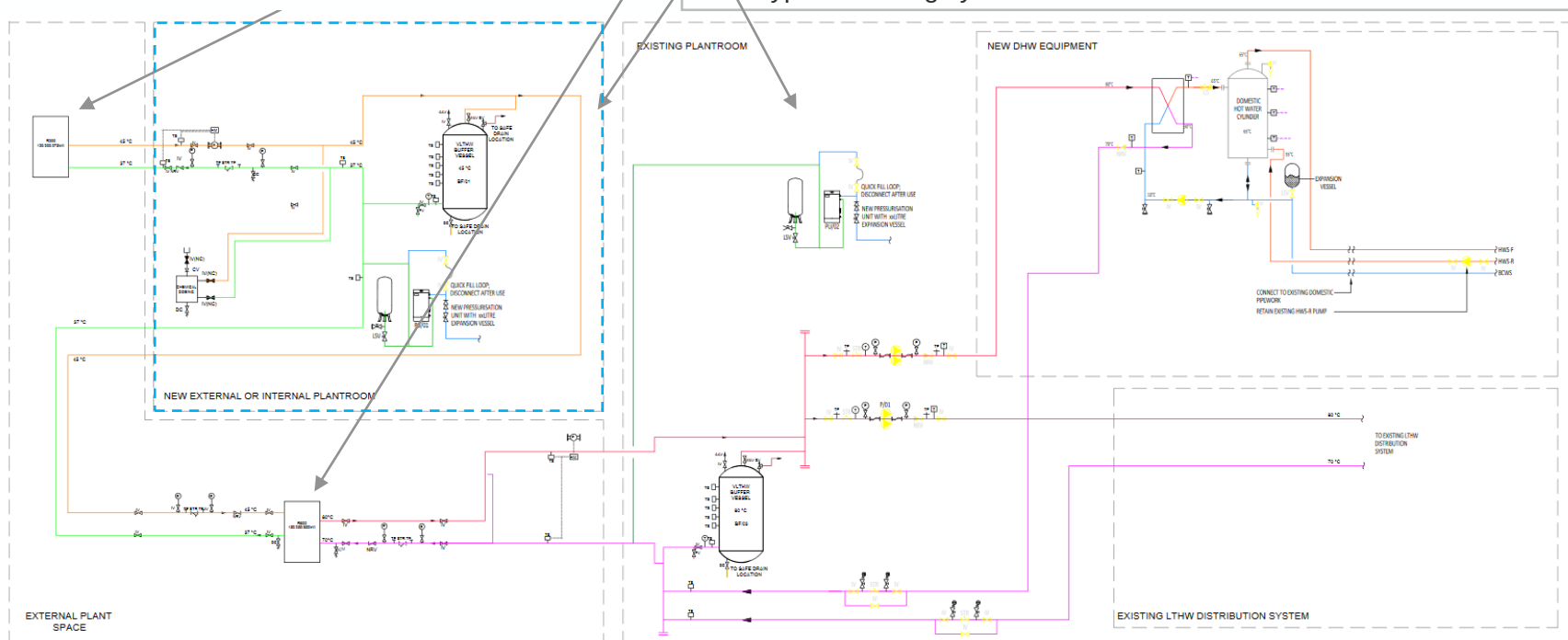
The Larch is a more complex heat pump than a conventional appliance. However, Clade take care of all of this with a cleverly designed complete system that also incorporates a degree of flexibility in the arrangement and location of the component parts. This means a Larch can fit on to most sites.

The major components are: Clade supplied

- The low temperature air source heat pump(s)
- The high temperature water source heat pump(s)

Contractor or Clade supplied separately

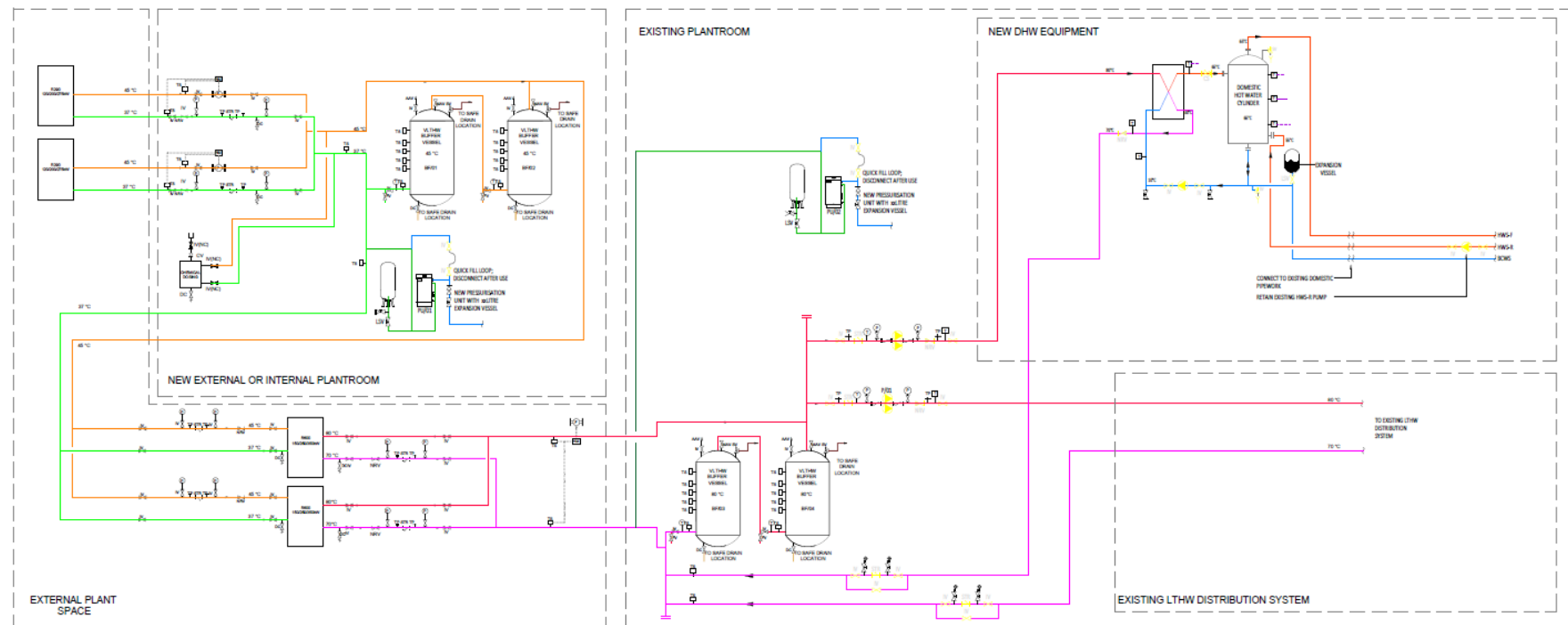
- The intermediate plant room with buffers, controls, pumps, power distribution etc.
- Typical existing system modifications etc.





LARCH SYSTEM HIGHER CAPACITIES //

The Larch is available up to 350KW in a single system. For higher capacities multiple units may be used together. In which case a parallel arrangement should be used as show in the below P&ID.





CASE STUDY //

This leisure centre example installation demonstrates the characteristics of a cascade heat pump system. In this instance the system is designed to deliver the full building duty of 560KW at 80/70°C. The size of the demand requires two LT ASHP and two HT WSHP connected by buffer tanks that aid smooth and therefore efficient operation.

The advantage of this arrangement is the direct replacement of boiler technology without affecting the wider heating system. No work was necessary in the building, the heat pump simply connected in to the boiler headers.

This example was installed early in 2022 but had to wait for DNO connections to be completed prior to commissioning. Subsequently there have been issues with the power supply and BMS which have lead to some outages etc.

This re-enforces Clades preference for a period of optimisation after commissioning to tune up heat pumps. Retro-fit is rarely simple!

Expected performance at 82/71°C at -5°C ambient

- 2 x 280kw r600a high temperature WSHP with a COP of 3.89
- 2 x 160kw r290 low temperature ASHP with COP of 2.81

Theoretical system **COP of 2.1**

Note that a cascade system uses two sets of compressors for one thermal output unlike a conventional heat pump which is one to one. This means the power consumption is higher and therefore the COP is lower.

The end user and designer must evaluate the relative benefits of modification to the building systems vs. lifetime cost of lower COPs.



Over the recent December cold period this heat pump has achieved a COP of 1.9.

The ambient dropped below design point and there were various service interruptions caused by external factors which are difficult to evaluate.

Clade will continue to monitor and work with the data to achieve the target outcomes.



THANK YOU //

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