FINAL REPORT

'Solar Assisted Ground Source'

Client Ref: RDD/00075

SUSTAINABLE ENERGY AUTHORITY OF IRELAND

ENERGY RESEARCH, DEVELOPMENT & DEMONSTRATION PROGRAMME 2016

NOVEMBER - 2016

DOCUMENT ISSUE SHEET

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	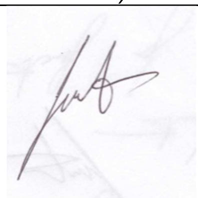			
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1. INTRODUCTION

The Solar Assisted Ground Source project seeks to test different ground source heat pump collector systems in Irish ground conditions, by combining new ground source collectors currently not available in Ireland and developing a hybrid ground source and solar thermal system for the Irish market. The five main objectives of the project are focussed on addressing key barriers to the development of the ground source sector in Ireland and Europe. These include:

1. Demonstrating the efficiency of different geothermal collector configurations in similar ground and operating conditions by using new collector configuration that improves performance by at least 20%

2. Demonstrating the efficiency of different geothermal collector configurations in similar ground and operating conditions by hybrid configuration to improve performance by at least 20%

3. Providing base line data on ground temperatures and collector operation from different collector configurations;

4. Providing new data demonstrating how combined solar thermal and ground source technologies can increase system SPF over a 25 year period;

5. Demonstrating the reduction in costs for a hybrid ground source heat pump systems by at least 20%.

2. PROJECT WEBSITE

Following the award of the contract a project website (http://www.solargroundsource.com) was set up. The domain was purchased and information regarding the project, the house and the collectors was posted. Updates and blog posts about the results of field tests and collector performance are periodically made available on this site.

3. DESIGN

Before any ground was broken on site, a comprehensive desktop study was performed to ensure correct and appropriate levels of technology were selected. It was also necessary to size the chosen technologies to the demand of the house.

3.1. COLLECTOR SELECTION

The ground source heat pump market in Ireland is currently limited the installation of 2 main types of closed loop collector that include PE100 single-U and a double-U.

The SAGS project objectives included testing and identifying the most efficient of these collectors against new collector technology. The collector selection process for a ground source system typically focuses on maximising the heat exchange area with the ground and on ensuring that a sustainable ground temperature are achieved throughout the lifecycle of the installation.

One of the ways this is achieved is by maximising the pipe surface area in the ground and/or by increasing the volume of collector. The double-U and the coaxial heat exchangers generally provide an increase pipe surface area, both of these technologies are readily available in other European markets. The double-U collector comprises two, 32mm diameter flow and two return pipes per length deployed.

The coaxial heat exchanger comprises an outer pipe through which the cold return from the heat pump is pumped down the hole. The heat exchange with the ground happens in this section of the boreholes with the warmed fluid being pumped back to the heat pump through the central pipe.

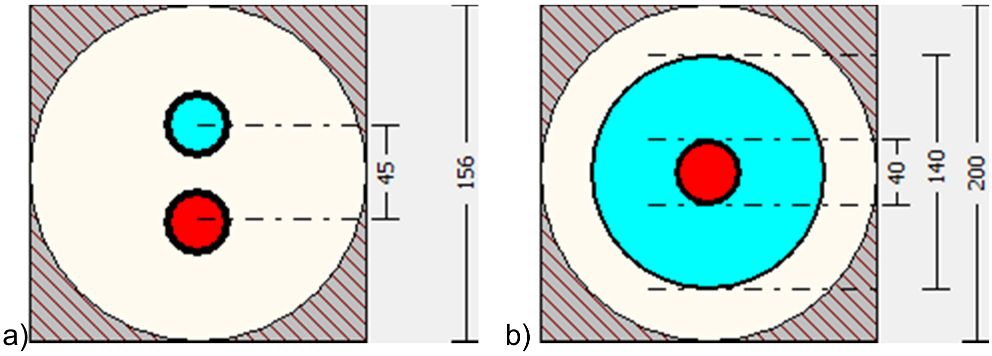

Figure 1: a) Single-U 40mm Collector b) geoKOAX™ Collector configuration. Blue = flow, red = return.

Following the review of the existing site conditions at the site, the thermal properties of the rock, and the energy demand of the residential development, an initial estimate of 180m of single-U or double-U pipe were identified as the main collector requirements, based on a heat extraction rate of 37 W/m of collector (IGTP, 2015).

The most common of the collectors in the Irish market is the single-U, comprising single 40mm flow and return PE 100 pipes.

Coaxial heat exchangers are not available in Ireland. These are commonly used as stainless steel heat exchangers in the UK and parts of Europe. Whilst their performance is better and installation costs are improved in some cases due to shorter installation depths, the cost of collector materials is high compared to conventional PE collectors.

The SAGS projects seeks to test new collector types against the conventional systems used in Ireland. Based on the initial market research, a single-U collector alongside with a geoKOAX™ coaxial heat exchanger were selected for this project. The latter will be an innovation in the Irish market. The geometric concept of the geoKOAX™ system means that the contact surface area for geothermal heat is twice as large as that of conventional geothermal probes. The core of the geoKOAX™ heat exchanger provides passive turbulence, resulting in continuous change from laminar flows to turbulent flows and increasing the heat transfer coefficient by 20%. This final innovation of this probe is it's diameter of 140mm (figure 1b) which allows up 6.5 times more carrier fluid than a single-U collector to be stored in the ground. Initial field trials in other parts of Europe demonstrate this significantly decreases heat pump cycle times at the operational stage. The geoKOAX™ probe is typically installed in unconsolidated sediment and the SAGS project seeks to test its performance in hard rock conditions.

Figure 2: View of the inner and outer tubes of the GeoKoax during welding.

The installation of the geoKOAX™ collector is very different to that of a conventional collector. A conventional collector is typically delivered to site as a reel and a spool is used to lower the collector in the borehole. The geoKOAX™ system comprises fixed pipe lengths as well as a header and foot section for each probe. The sections need to be individually butt welded and the whole probe sections completed in advance of being lowered in the borehole. An induction on the installation of the system was completed by the project team in mid-July 2016.

3.2. BUILDING CHARACTERISTICS & HEAT DEMAND

The detached house proposed in the case study for the project is a newly built house of 257.40m^2 in size and a total volume of 696.78m^3.

The preliminary calculation based on the building fabric proposed and the installation of a 9.5kW S10 Neura Ground Source heat pump, 6.84m^2 of CPC 18 Latento tube panels with a 500L cylinder and a solid fuel stove gives a BER rating of A3.

An annual hot water demand of 3,383 kWh/year and a heat use for the full year of 11,500kWh per annum have been calculated (table 1).

Table 1: Calculation of heat loads for project.

Heat Loads from Druids Glen Dwelling report

Heat loads	kWh	MWh	
January	2293	2.293	
February	1826	1.826	
March	1424	1.424	
April	885	0.885	
May	326	0.326	
June	0	0	set to 0 due to heat pump being off
July	0	0	
August	0	0	
September	154	0.154	
October	743	0.743	
November	1590	1.59	
December	2260	2.26	
total	11501	11.501	

The dwelling report results and the technical sheets for the proposed equipment are included in Appendix A.

3.3. SYSTEM SCHEMATIC MODEL

The objective of the SAGS project is to test the potential to increase the ground source system efficiency over the lifetime of operation of the system. Typical ground source systems installed in a domestic setting in Ireland have little or no cooling demand and operate in heating mode only.

The heat only operational profile of the heat pump results in an overall decrease in ground temperature over a 25 year operational period based on the average natural geothermal heat flux of $0.06W/m^3$ for the earth's crust in Ireland. The operational performance of the heat pump and the ability of the heat pump to efficiently extract the energy required, are therefore strongly influenced by the change in ground temperature over the life cycle period and requires adequate collector length installation and design based on the ground conditions.

A typical design parameter used for domestic systems to ensure efficient collector operation is to allow for the collector and ground temperatures not drop below 0^oC in the month of highest heat demand or ensuring that the temperature of the thermal transfer fluid entering the heat pump shall be designed to be $>0^oC$ at all times for 20 years in normal operating conditions (MCS, 3005).

A number of previous projects supported by SEAI have studied collector performance in Ireland based on heat pump logger data (IGTP, 2015). A temperature differential of between 2^oC and 4^oC between the flow and return temperature in a ground source collector are typical in domestic ground source systems. This temperature differential contributed to the lowering of the ground temperature over the long term operation of the system.

The objectives of the SAGS project are to reduce the effect on the ground and using a hybrid solar thermal installation to minimise the ground temperature decline. Figure 3 below proposes a conceptual schematic of the system proposed at the site. This schematic has been developed following extensive consultation and modelling of the potential temperature profiles expected from the solar thermal systems in the period where the heat pump is likely to be in operation. Careful consideration was given to previous research in using this type of technology which overall resulted in significant increases in ground temperatures from storing solar thermal energy in the ground during the summer months. Avoiding adverse temperature impact to the ground was also carefully considered.

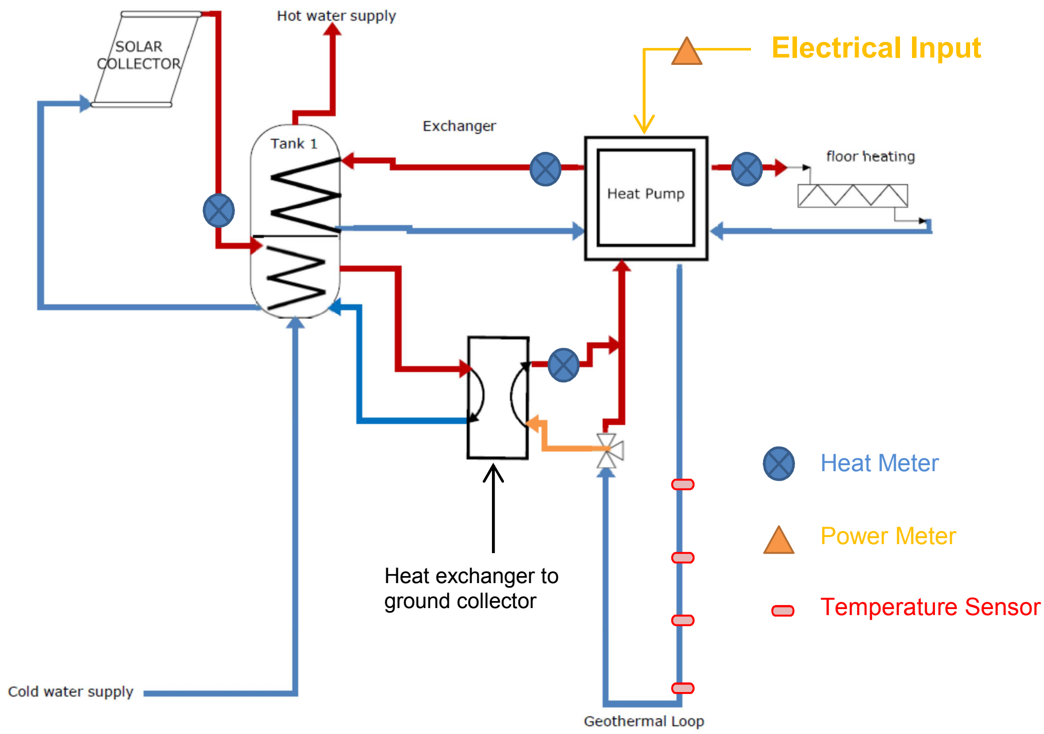

Figure 3: SAGS – Druid's Glen System Schematic

The following system design and operational considerations have been made based on the building design and energy demand analysis:

- Building heat demand will be nil during the summer months – June, July & August – with lower demand in May and September;
- The solar thermal collectors will provide the full domestic hot water demand during the summer months;
- The ground source heat pump will provide space heating and domestic hot water during the autumn, winter and spring months
- The ground source heat pump will be off for the June to August period
- The SAGS system must provide heat input at the time of operation of the heat pump only without affecting ground temperatures in the summer months when the solar thermal panel have their highest temperatures.

The SAGS system therefore proposes use a tank with a baffle plate for the domestic hot water. The lower part of the tank will circulate the solar thermal transfer fluid to a heat exchanger connected to the ground loop of the heat pump. The fluid transfer and heat exchange will only circulate when the heat pump is in operation and the collector pump is cycling. The proposed temperature for the heat exchanger will be limited to a maximum of 18°C.

The following section of the report discuss the modelling that has been undertaken to size the ground source collector more importantly to understand what the impact on ground temperatures might be when the hybrid system is in operation.

3.4. COLLECTOR PERFORMANCE MODELLING

The Druid's Glen site is located on the Bray Head Formation comprising greywackes and Quartzites. The Bray Head formation is considered a poor aquifer only productive in local zones and especially where fractures are present. The Geological Survey of Ireland Groundwater database shows the presence of some groundwater supply boreholes located to the east and north east of the site where low yields have been recorded.

The estimated thermal conductivity of the Bray Head formation is given as 2.3 W/m/K from previous laboratory testing results (IGTP, 2015).

EED and GLD software was used to estimate the required borehole length for the proposed 9.5kW ground source heat pump system and the estimated heat demand based on using a single-U 40mm collector. A total estimated length of 180m has been modelled as the total collector pipe length. A similar exercise has been carried out using geoKOAX software to solve the total pipe length requirement for the proposed collector where a total of 86m of pipe length has been established.

Drilling of the boreholes for the collectors took place on the 14th, 15th and 16th September 2016.

To facilitate the installation of the 140mm geoKOAX pipe collector at the site, it was decided to install this as 2 No. 43m deep borehole, with the comparative single – U probe as a single 120 m probe.

The collector spacing is 5m apart between individual probe sections. Figure 4 provides a schematic of the borehole positions.

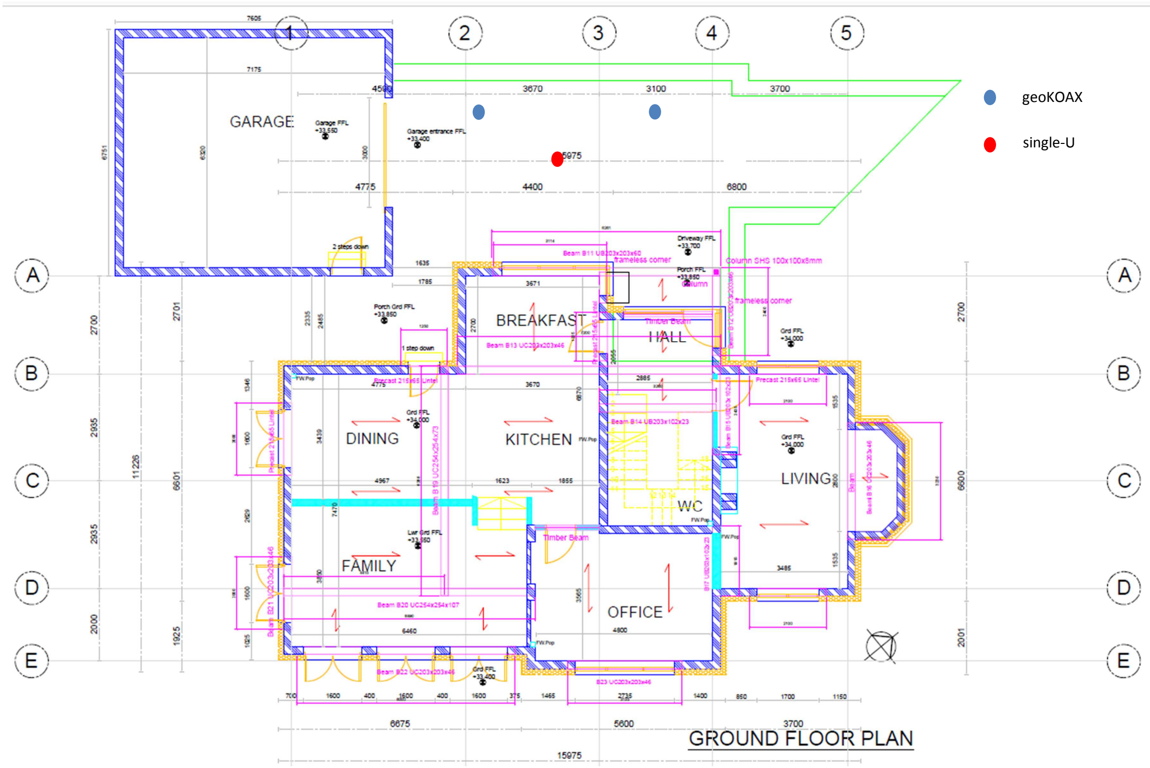

Figure 4: Druid's Glen System – Proposed collector positions

A preliminary set of models have been completed to demonstrate the benefit of the SAGS system. The ground model has focussed on assessing the potential impact of using the solar thermal collector to increase the collector fluid temperature. The system operational model focuses on the ground temperature model results to predict the long term operational effect of the collector temperature. These are further discussed in the sections below.

3.5. GROUND TEMPERATURE MODEL

A computational fluid dynamic model was used to simulate fluid and ground temperature changes over the operational life time of the system. The objective of this model is to understand how temperature would rise from the solar thermal input based on a set of temperature parameters (table 2) that may be supplied to the heat exchanger connected to the ground loop (refer to Figure 3).

Table 2: SAGS – Solar Thermal input temperatures modelled.

Temperature (°C
11
13
15
17
20

The collector was modelled as 2 individual pipes of 40mm in diameter for the flow and injection points in the collector. The lower section of the borehole was modelled as a U shaped cell in a very low porosity rock. The computational mesh was a 500,000 m^3 volume of 4000 cells of 125 m^3 each. The same geological and thermal properties were modelled on the Druids Glen case as closely as possible.

The software models the ground temperature change with injection of different temperatures (table 2) over a 25 year period. The results are represented graphically and a zone of influence can be seen increasing between year 1 and year 25 (Figure 5 and Figure 6).

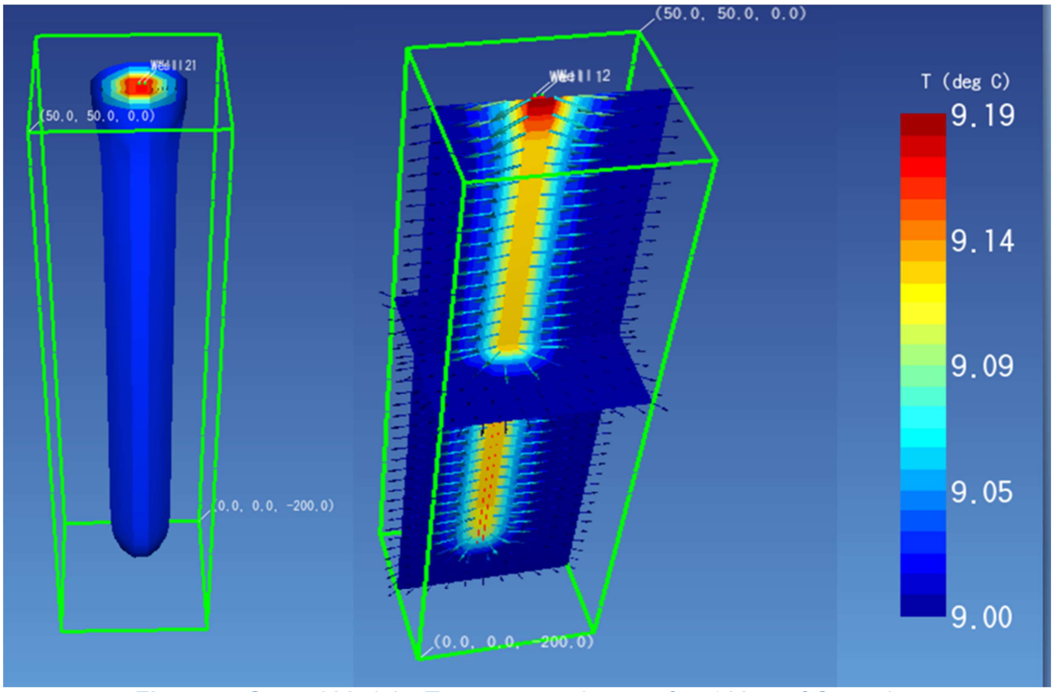

Figure 5: *Ground Model – Temperature change after 1 Year of Operation*

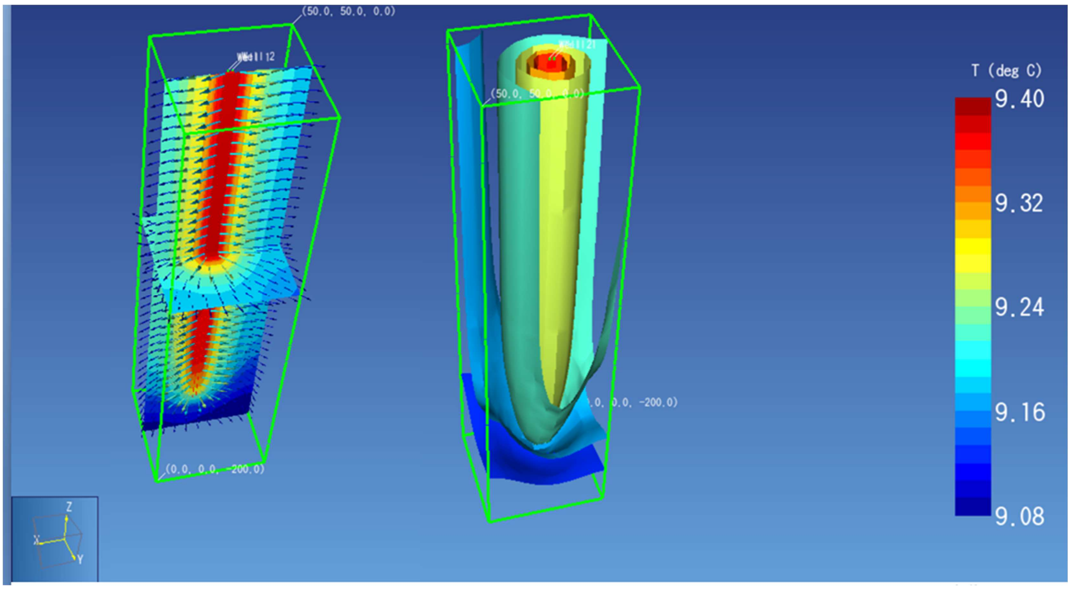

Figure 6: SAGS – Ground Model – Temperature change after 25 Years of Operation

The observed ground temperature increases rapidly over the first 1 to 3 years of production (depending on the injection temperature) at which point a relative steady state is achieved with the temperature changing at a lower steady rate over time. A summary of the temperature changes is shown in Figure 7 below.

The slope of the linear part of the line is the long term heating rate, and the x intercept is equilibrium point once steady state heating begins. This value is used as the input temperature for the ground the in system operational model discussed in the next section.

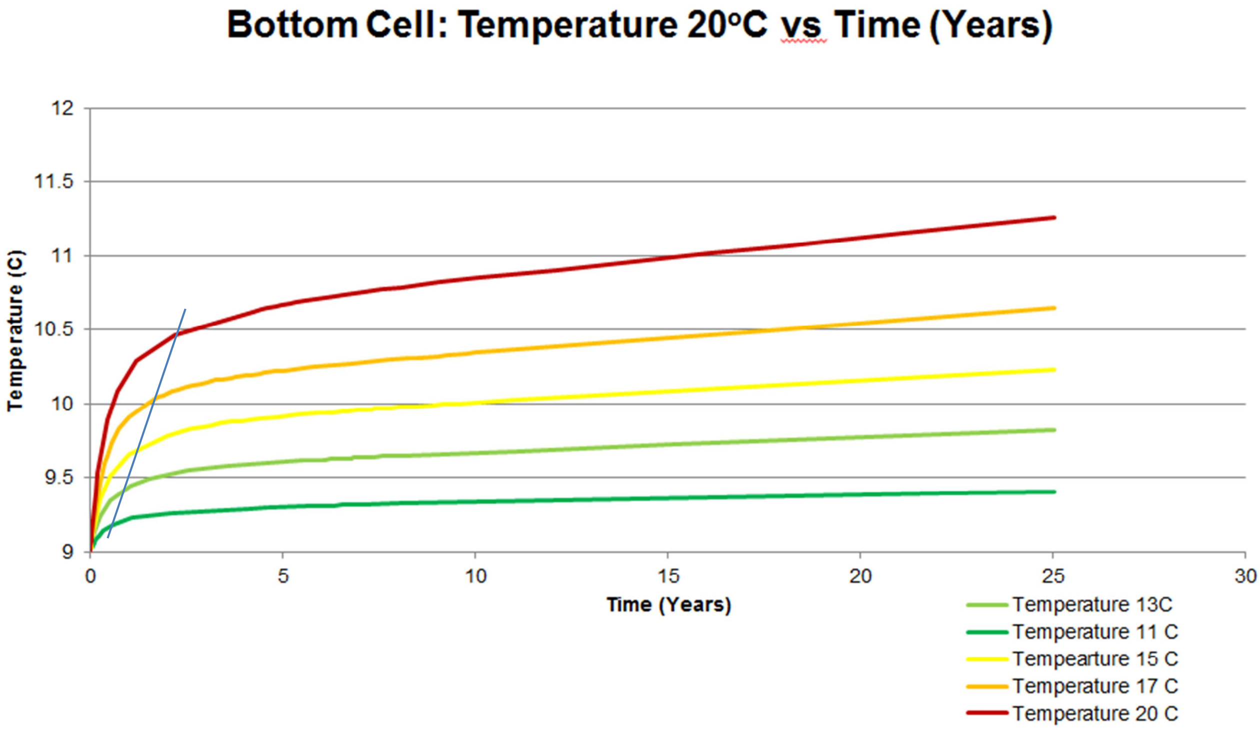

Figure 7: SAGS – Ground Model – Bottom Cell Temperature change over 25 Years

3.6. SYSTEM PERFORMANCE MODEL

The ground modelling demonstrates the potential elevated temperatures that can be achieved over the operational period of the system when the solar thermal collector is connected to the ground loop. The system performance model uses the data from the ground temperature model to demonstrate the effects of the SAGS system when the estimated heat load of the house is applied.

The inflection point of the curve (represented by the blue line in Figure 7) has been considered in this case as the 'increased' ground temperature and the input for the operational model of the system. The heat demand from the system and heat pump characteristics were used in GLD and EED software to compare the change in ground temperature from a normal system without the SAGS.

These initial modelling results show that overall heat extraction using the SAGS systems significantly lowers the long term impact on the ground temperature.

Table 3: SAGS – Ground temperatures after heat extractions and injection

Injection Temperature (°C	11	13	15	17	20	No SAGS
Modelled Ground Temperature	9.34	9.7	10.024	10.34	10.81	9
Year 1	12.08	12.44	12.76	13.08	13.55	11.74
Year 2	7.65	8.01	8.33	8.65	9.12	7.31
Year 5	7.36	7.72	8.04	8.36	8.83	7.02
Year 10	7.23	7.59	7.91	8.23	8.7	6.89
Year 25	7.09	7.45	7.78	8.09	8.56	6.75

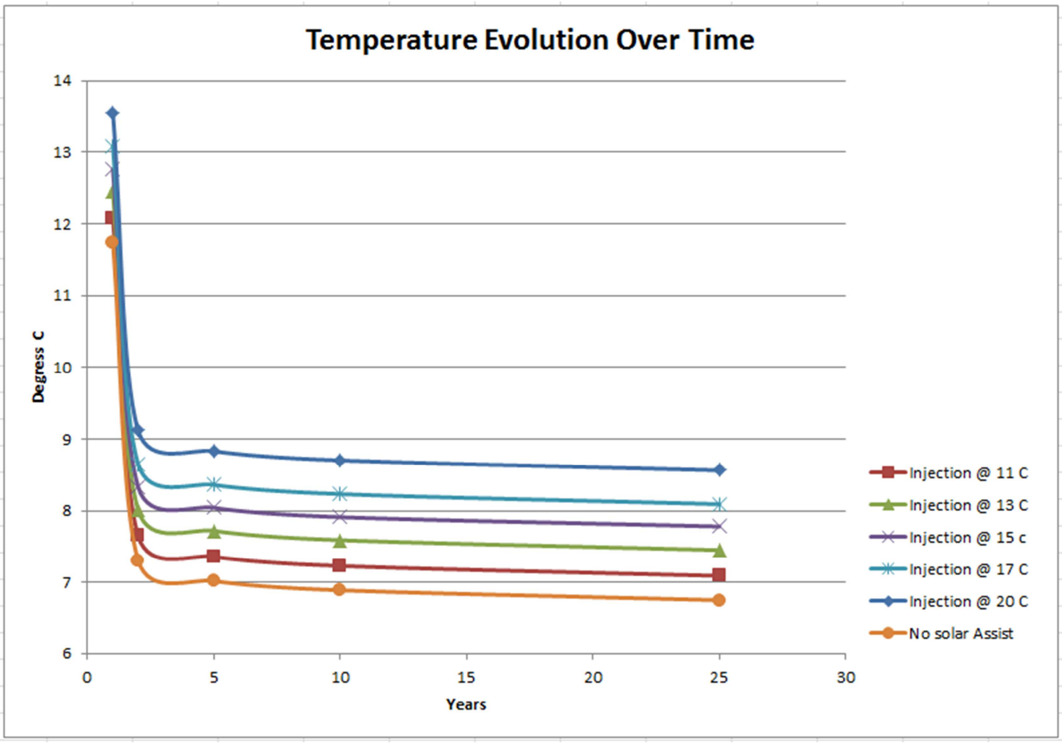

Figure 8: SAGS – System Model – Ground Temperature change over 25 Years of operation of the proposed case study system

These models have considered the effects of the two part of the SAGS systems on the ground. Namely the effects of injection of low temperatures into the ground collector through the ground loop, and the effect on the ground due to a higher starting ground temperature (Figure 8).

The results of the second modelling phase will be reviewed against the field data to be collected for the system by TRTs, the downhole thermocouple sensor system and all other sensors to be deployed in the build.

4. DRILLING AND COLLECTRO INSTALLATION

4.1. DRILLING

The drilling of the boreholes took place the 14^{th}, 15^{th} and 16^{th} September 2016. The drilling was done by Walls Water Drilling using an Ingersol Rand T3W truck mounted rig. Drilling began with the GeoKOAX borehole nearest the garage (see Figure 4) and installation of the collector on the $14^{th.}$ The 15^{th} saw the second GeoKOAX hole and collector completed and installed, and the 16^{th} the deeper u-pipe borehole and installation of that collector. Installation of the collectors also involved the installation of a downhole measuring system as outlined in section 5.1

Figure 9: Drill rig.

The U-pipe collector is easily installed, via simply unreeling from a spool down the hole. The geoKOAX had a more complicated arrangement involving the butte welding of 6m sections on site into a full 43 m length.

Figure 10: Butt Welding of GeoKOAX sections.

This was lowered into the hole using the boom of the drilling rig mast and hoist. This was a complicated process which involves filling the collector with water and carefully feeding it down the hole.

Figure 11: Installation of the welded of the GeoKOAX collector down the borehole with grout tube.

4.2. GROUTING

The grouting of the holes took place on 23rd September 2016. The grout is a thermally conductive cement that is injected down the borehole to fill the space between collector and rock wall. The grout is mixed on site and injected downhole from the bottom upwards via a 30mm pipe. The grout used was THERMOCEM PLUS with a rated thermal conductivity of 2.0 W/mK.

Figure 12: Grout entering via blue pipe, and displacing water out the top of hole.

4.3. HEADER PIPE CONNECTION

The main header flow and return pipes from the collector were installed and placed in a trench. All flow returns were connected to a manifold, and then pipe work brought to garage for eventual connection to the Heat Pump. The downhole sensor system was also buried in this trench. Trenches were then closed in.

Figure 13: Trench work, flow/return pipes and cased borehole.

5.1. DOWNHOLE MONITORING SYSTEM

One of the objectives of the SAGS project is to collect data on the change in ground temperature from different collector types during system operation. To this end a system of temperature monitors was devised to be placed in the geoKOAX hole and the U-pipe hole. Various options were investigated such as fibre optics, daisy chained computer controlled sensors and powered thermistors.

Thermocouples were selected as the most effective and technology for monitoring given the requirements of installation at the time of the installation of the probe. Thermocouples are two dissimilar metals connected to form a junction. The temperature of this junction varies with the temperature allowing it to be read by a data logger. Four thermocouples were installed in each borehole at varying depths. The thermocouples were connected to a data logger to record temperature changes continuously during operation of the system at an interval of 15 minutes for.

400m of type J thermocouple cable was used and divided into 2 sets of 4 cables per hole. Each cable was cut to a predetermined length since it is the end of the thermocouple cable that provides the sensing ability. These lengths staggered at 20m in the U pipe and 10 m in the geoKOAX (Figure 14). The depths illustrated are the depths below ground level. The thermocouples were attached to the collectors as they were being inserted into the boreholes. The depth was determined by the remaining length of thermocouple cable above ground. The setup as shown in Figure 14 returns temperature data at 86m, 66m, 46m, and 26m below ground level for the U-pipe and 37m, 27m, 17m, and 7m below ground level for the geoKOAX

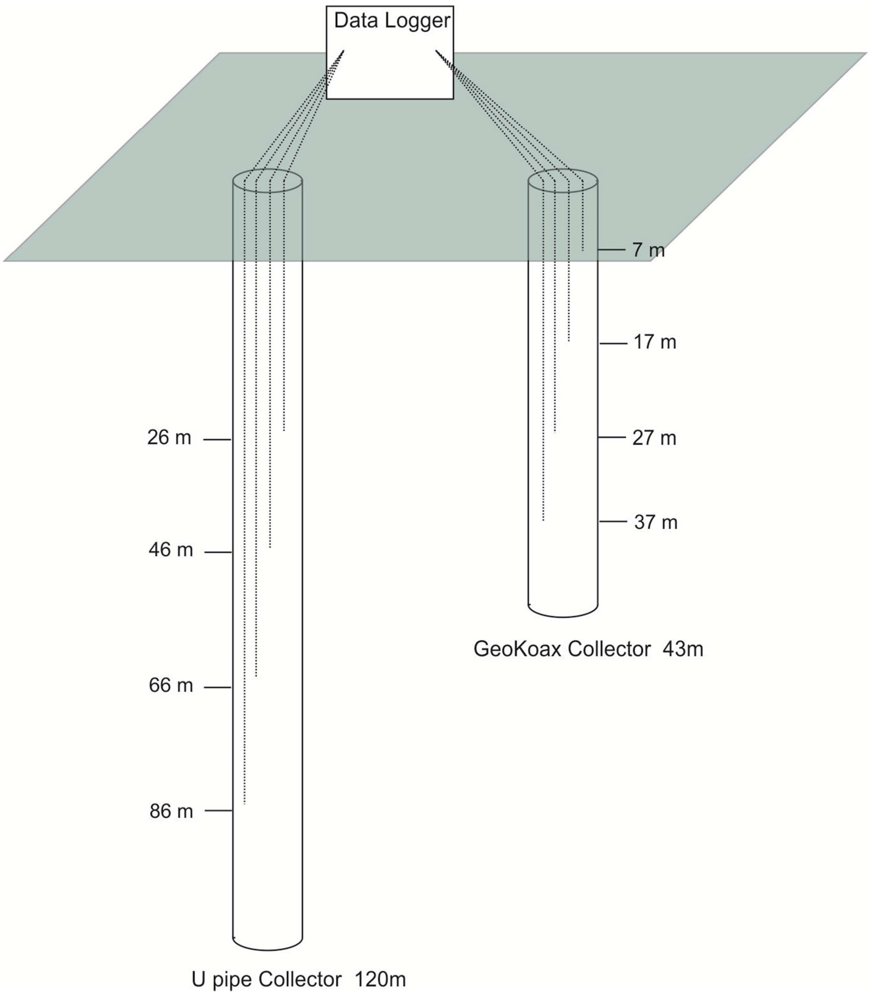

Figure 14: Thermocouple sensor system installed.

These thermocouple cables were continued form the borehole, back to the house (via an underground pipe buried in the driveway). The cabling is connected to a mini PC and TP 08 data logger. Since the house in not powered as of time of writing this system is ready to begin temperature logging, and is awaiting electricity to do so.

Logging will be automatic and continuous at an interval of 1 reading of the entire system every 15 minutes, The logger will read each of the sensors at each depth as illustrated in Figure 14 as well as temperature check on the logger itself , for a suite of 9 data points every 15 minutes. This is then stored locally on the mini PC, and will be read remotely as needed.

Figure 15: 4 thermocouples cables (in red wrap) inserted into the GeoKOAX borehole.

The 8 thermocouples will provide live temperature readings from down the hole once the system is in operation and will allow to record the effects of using the solar thermal panel as temperature inputs in the winter and measure the ground temperature response as part of the long term operations of the system.

The downhole sensor system will also be used, but at a resolution of 1 minute for the duration of the TRT tests, to gather additional information on the ground response. This is especially useful as the TRT can be conducted on the geoKOAX, and the temperature evolution several meters away noted via the U-pipe sensors. Thus more distant ground thermal response can be investigated.

5.2. ADDITIONAL MONITORING

In addition to the downhole monitoring system as outlined in the section above, a comprehensive monitoring and data acquisition programme is envisaged as part of the SAGS project using electricy and heat meters in key part so the system. The monitoring will also comprise energy usage from the heat pump, data from heat meters installed for the solar thermal collector, the heat pump buffer vessel for the DHW and the underfloor heating.

All of this will be collected and analysed in a holistic fashion, and ultimately released on the project website.

5.3. THERMAL RESPONSE TESTS

Two Thermal Response Tests (TRTs) on the collectors are planned, the first on the single-U and another on one of the geoKOAX collector.

A Thermal Response Test (TRT) involves applying a finite amount of heat energy into a closed loop borehole over a period of several days, while monitoring the rate at which heat dissipates into the surrounding ground. Closed loop vertical boreholes are installed in the ground to act as the energy collector for a ground source pump system.

Thermal response test data is used to calculate the effective thermal conductivity of the ground and the borehole thermal resistance. This calculation is performed using the Kelvin's Line Source theory (Eklöf & Gehlin, 1996) which implies steady state conditions in the borehole and a measured response from a heat input to the surrounding bedrock. Drilling has revealed water as present in the boreholes on site. The presence of groundwater flow in the borehole can mask the effective thermal conductivity of the ground and makes the estimation of the thermal properties of the ground more difficult.

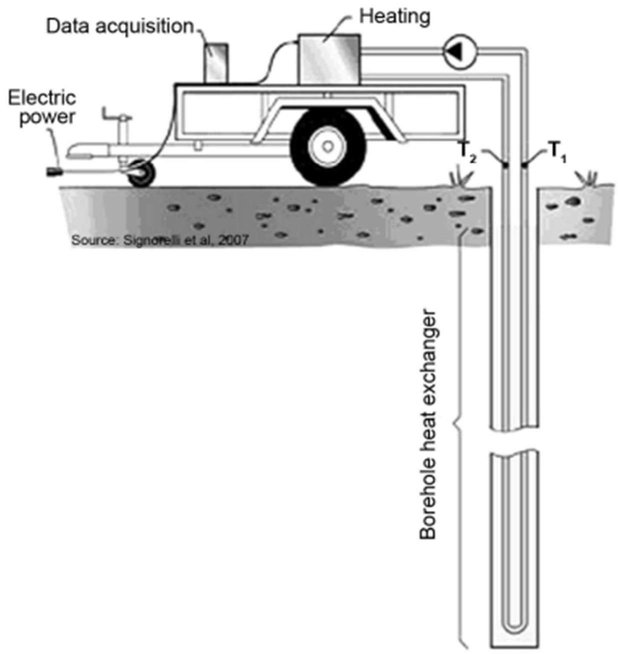

Figure 16: Schematic of a TRT

The portable TRT equipment will be connected to the collector pipe at surface. The collector loop will be filled with water and sealed in advance of beginning the test. Care will be taken to carefully insulate the pipe connections between the equipment and the collector to minimise heat loss during the course of the test.

A 3kW electric water heater will be used to apply a steady temperature of typically 8°C to 16°C to the water in the collector pipe which will then be circulated at a set flow rate using a small water pump for a minimum duration of 72 hours. An additional 6kW of heat generation is available, but it may be too much for the loop to take without melting. Given the longer length of the U-pipe this additional heat may be needed in this case.

Temperature sensors fitted to the flow and return pipes measure the temperature difference between the water entering and exiting the collector pipe. This data can then be read remotely by the technician. It is this data than is used to determine the ground thermal conditions.

Figure 17: Thermal Response Test rig. Note insulated connections to heat collector at left.

It is planned to carry out the thermal response tests Week commencing 5th December when power connection to the site will be completed.

6. CURRENT STATUS AND PROBLEMS ENCOUNTERED

As of end of November 2016, all collectors have been installed, grouted, and all associated pipe work brought to garage awaiting heat pump connection. All trench work has been filed in. Downhole monitoring system is ready and awaiting electrical connection.

The project operations and tasks encountered some operational and timing related problems that have now been encountered. These are discussed briefly below and revised table of expected deliverables presented:

- The lack of electricity on site has delayed the Thermal Response Test of the boreholes. This is now planned for second week in December 2016.
- Installation of solar panels and heat pump was delayed but has been completed and connected to the system has been achieved.
- The order of the heat pump and associated buffer vessel and equipment were delayed as a result of the unfinished floors and windows in the house. The pipe work and connections to the solar thermal system and the buffer vessel are installed. The heat pump is scheduled for delivery on the 5th of December and connection on the 7th of December.
- Following the completion of the TRT test, the system will be filled and commissioned. The system will then be switched on and in operation from the 16th fo December onwards.

A revised task outline illustrates the milestones, in Table 4, below.

Table 4: Revised Task Timeline

Type	Status	Expected Completion or Completion Date
System Specification and Modelling	Completed	-
Project Website Setup	Ongoing	-
Collector Selection	Completed	-
Drilling and Collector Installation	Completed	
Thermal Response Tests	Awaiting Completion	Week commencing 5th December
Solar Thermal and Heat Pump Installation	Awaiting Completion	7th December 2016
Final System Commissioning and Pressure Testing	Awaiting Completion	Expected by the 16th December 2016
System Monitoring Installation	Awaiting Completion	From the 16th December 2016

7. INTENDED OUTCOMES

The SAGS project is ongoing at this time. As data becomes avail be on completion and occupancy of the house, results and conclusions will be posted to the SAGs website. Expected deliverables include

- A comprehensive data set of the evolution of ground temperatures over time due to heat extraction from the geothermal system. 8 thermocouple sensors embedded in the ground in the two boreholes will provide a suite of real time data to better understand the extent of the heat draw from the surrounding rock. The sensors are attached to a geoKOAX and the U-pipe, only one of which will be used to heat the house at a given moment. Both of these sets can be used to measure both the near field and far field effect of heat extraction in respect to the working borehole.
- A regularly updated website with regular posts and insights on the project.
- Data from the heat pump, solar panels and elsewhere in the house to be combined and interpreted.

This data will help achieve the initial 5 objectives of the SAGS project, namely:

- Demonstrating the efficiency of different geothermal collector configurations in similar ground and operating conditions by using new collector configuration that <u>improves performance by at least 20%</u>
- Demonstrating the efficiency of different geothermal collector configurations in similar ground and operating conditions by <u>hybrid configuration to improve performance by at least 20</u>%
- Providing base line data on ground temperatures and collector operation from different collector configurations;
- Providing new data demonstrating how combined <u>solar thermal and ground source technologies can increase system SPF</u> over a 25 year period;
- Demonstrating the reduction <u>in costs for a hybrid ground source heat pump systems by at least 20%</u>.

8. REFERENCES

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APPENDIX A

BER – Dwelling Report

Letanto Solar Thermal Panel Specifications

Neura S10 Heat Pump Details

Dwelling Details Report

Property Details

Dwelling Type	Detached house	**Type Of BER Rating**	New Dwelling - Provisional	**Has a rating been previously submitted?**	False
Address line 1	No. 6 Druids Avenue	**Year of Construction**	2016	**BER Number**	
Address line 2	Druids Glen	**Date of Assessment**	30/05/2016	**Your Ref.**	16 / 10189
Address line 3		**Date of Plans**	30/05/2016	**MPRN No.**	
County	Co. Wicklow	**Planning Reference**		**Is MPRN shared with another dwelling?**	False
Post Code		**Building Regulations**	2011 TGD L	**Shared BER Number**	
		Purpose of rating	New dwelling for owner occupation		

Comment

Owner Name	John McAteer		
Address line 1	No. 6 Druids Avenue	**Phone**	
Address line 2	Druids Glen	**Email**	
Address line 3			
County	Co. Wicklow		
Post Code			
Assessor Name	Bryan Doherty		
Assessor Reg No.	102605		
Developer Name			
Development Name			

Dimension Details

	Area [m²]	Height [m]	Volume [m³]
Ground Floor	133.20	2.90	386.28
First Floor	124.20	2.50	310.50
Second Floor	0.00	0.00	0.00
Third and other floors	0.00	0.00	0.00
Room in roof			0.00
Total Floor Area	257.40		696.78
Living Area [m²]	20.00	**Living area percentage**	7.77
No of Storeys	2		

Ventilation Details

	Number	Air Change Rate [ac/h]		
Chimneys	1	40		
Open Flues	0	0	**Is there a draught lobby on main entrance?**	No
Fans & Vents	3	30	**Draught lobby air change [ac/h]**	0.05
Number of flueless combustion room heaters	0	0	**Openings infiltration [ac/h]**	0.15

Has a permeability test been carried out? Yes

Structure Type	Not Applicable	**Infiltration rate due to structure [ac/h]**	0.35
Is there a suspended wooden ground floor?	Not Applicable	**Intermediate infiltration rate**	0.50
Percentage windows/doors draught stripped [%]	Not Applicable	**Number of sides sheltered**	2
Adjusted result of air permeability test [ac/h]	0.350	**Adjusted infiltration rate**	0.43

Ventilation method Whole-house extract ventilation

Effective air change rate [ac/h]	0.68
Ventilation heat loss [W/K]	155.30

Manufacturer and Model name	Aereco	XL	
Specific fan power [W/(l/s)]	0.250	**How many wetrooms (incl. kitchen)? Is the vent. ducting flexible/rigid/both?**	5
Heat exchanger efficiency [%]	0.000		
Electricity for ventilation fans [kWh/y]	212.52		
Heat gains from ventilation fans [W]	0.00		

Building Elements

Doors

Type	Description	U-Value [W/m²K]	Area [m²]	Heat Loss	Number of doors
	Hall	2.000	2.000	4.00	1

Floors

Type	Description	U-Value [W/m²K]	Area [m²]	Heat Loss	Underfloor Heating
Ground Floor - Solid		0.150	133.000	19.95	No

Roofs

Type	Description	U-Value [W/m²K]	Area [m²]	Heat Loss	Insulation Thickness
Pitched Roof – Insulated on Rafter		0.100	160.000	16.00	Unknown

Walls

Type	Description	U-Value [W/m²K]	Area [m²]	Heat Loss	Semi Exposed
300mm Filled Cavity		0.210	222.000	46.62	n/a

Windows

Ref	Description	Orientation	Frame Type	Frame Factor	Glazing type	Eff. collecting area [m²]	Solar Transmit.	Area [m²]	Adj. u-value [W/m²K]	User defined u-value	Gap	Roof Window	U Value	Overshading Desc
1	W. 1 - 10	Southeast	Wood/PVC	0.700	Triple-glazed, argon filled (low-E, en = 0.05, soft coat)	8.90	0.570	32.200	1.236	False	>=16mm	False	1.300	Average or Unknown
2	W. 11 - 14	Northeast	Wood/PVC	0.700	Triple-glazed, argon filled (low-E, en = 0.05, soft coat)	3.65	0.570	13.200	1.236	False	>=16mm	False	1.300	Average or Unknown
3	W. 16 - 22	Northwest	Wood/PVC	0.700	Triple-glazed, argon filled (low-E, en = 0.05, soft coat)	3.59	0.570	13.000	1.236	False	>=16mm	False	1.300	Average or Unknown

4	W. 15 & 15A	Southwest	Wood/PVC	0.700	Triple-glazed, argon filled (low-E, en = 0.05, soft coat)	1.11	0.570	4.000	1.236	False	>=16mm	False	1.300	Average or Unknown

Heat Loss Details

Total glazed area [m²]	62.40	**Glazing ratio**	0.09
Total glazed heat loss [W/K]	77.11	**Summer solar gain [W/m²]**	0.00
Total effective collection area [m²]	17.25		
Total element area [m²]	579.40		
Total plane heat loss [W/K]	163.68		
Thermal bridging factor [W/m²k]	0.1500		
Fabric heat loss [W/K]	250.59		
Total heat loss [W/K]	405.89	**Per m²**	1.58

Water heating

Are there distribution losses?	Yes	**Is supplementary electric water heating used in summer?**	No
Are there storage losses?	Yes	**Is there a combi boiler?**	No
Is there a solar water heating system?	Yes		
Standard number of occupants	6.11	**Total hot water demand [kWh/y]**	3979.58
Daily hot water use [Litres/d]	187.00	**Solar hot water input, Qs [kWh/h]**	1977.12
Hot water energy reqs. at taps [kWh/y]	3382.64	**Solar fraction [%]**	49.68
Distribution Losses [kWh/y]	597		
Water storage volume [Litres]	500	**Temperature factor unadjusted**	0.60
Is manufacturers declared loss factor available?	No	**Temperature factor multiplier**	0.90
Manufacturer and Model name		Neura	
Declared loss factor [kWh/d]	2.600		
Insulation type	Factory Insulated	**Hot water storage loss factor [kWh/l d]**	0.015
Insulation thickness [mm]	50	**Volume factor**	0.62
Combi-boiler Type			
Keep Hot facility	None		
Combi-boiler loss [kWh/y]	0.00	**Combi-boiler electricity consumption [kWh/y]**	0.00
Storage Loss	929.99	**Adjusted storage loss [kWh/y]**	651.00
Primary Circuit loss type	Boiler with insulated primary pipework and with cylinder thermostat		
Primary circuit loss [kWh/y]	360	**Adjusted primary circuit loss [kWh/y]**	455
Is hot water storage indoors or in group heating system	Yes	**Heat gains from water heating system [W]**	240.17
Output from main water heater [kWh/y]	3108.36	**Output from supplementary heater [kWh/y]**	0.00
Annual Heat gains from water heating system [kWh/y]	2103.90		

Solar Water heating

Solar panel manufacturer	Latento
Solar panel model	CPC 18

Aperture area of solar collector [m²]	6.000	**Dedicated storage volume [Litres]**	150.00
Zero loss collector efficiency η_0	0.642	**Solar storage combined?**	Yes
Collector heat loss coefficient, a1 [W/m²K]	0.885	**Total Volume of Cylinder [Litres]**	500
Collector performance ratio [W/m²K]	1.38	**Effective solar volume**	255.00
Annual Solar Radiation [kWh/m²]	1021	**Daily hot water usage**	186.86
Overshading factor	0.800	**Volume Ratio**	1.36
Solar energy available [kWh/y]	3146.31	**Solar storage volume factor**	1.06
Solar to load ratio	0.79	**Solar hot water input [kWh/h]**	1977.12
Utilisation factor	0.72		
Is there a cylinder stat?	Yes		
Adjusted utilisation factor	0.72		
Collector performance factor	0.82		
Is solar water heating pump solar powered?	No		
Electricity consumption of SWH pump [kWh/y]	75.00		

Lighting and Internal Gains

Basic energy consumption for lighting [kWh/m²y]	9.30	**[kWh/y]**	2393.82
Percent low energy fixed lighting outlets [%]	100		
Annual energy used for lighting [kWh/m²y]	1151.00		
Internal gains from lighting during heating season [kWh/hs]	881.00	**In watts [W]**	151.00

Lighting	151.00
Appliance and cooking	461.95
Water heating	240.00
Occupants	305.00
Mechanical ventilation	0.00
Heat loss to the cold water network	-69.00
Net internal gains	1090.00

Net Space Heat Demand

Required temperature during heated hours	21	
Required temperature rest of dwelling	18	
Living area percentage	7.77	
Required mean internal temperature [C]	18.23	
Thermal mass category of dwelling	Medium	
	Utilisation factor	**Intermittent heating**
Internal heat capacity of dwelling [per m²]	0.20	0.11
Internal heat capacity [MJ/K]	51.48	28.31
Length of one unheated period [h]	8	
Unheated periods per week	14	
Heat use during heating season [kWh/y]	11231	
Heat use for full year [kWh/y]	11499.89	

Space heat demand details

Month	Mean External Temp [C]	Adj Internal Temp [C]	Heat Loss [W]	Heat Use [kWh]	Gain/Loss Ratio	Utilisation Factor	Heat Use [W]	Useful Gains [W]	Solar Gain [W]
January	5.3	16.67	4617	2293	0.34	0.98	3082	1535	474
February	5.5	16.7	4546	1826	0.42	0.97	2717	1828	798
March	7	16.88	4010	1424	0.56	0.93	1913	2097	1163
April	8.3	17.04	3546	885	0.76	0.86	1229	2317	1591
May	11	17.36	2582	326	1.18	0.7	439	2144	1966
June	13.5	17.66	1690	82	1.8	0.52	114	1576	1953
July	15.5	17.9	976	12	2.99	0.33	17	959	1831
August	15.2	17.87	1083	21	2.58	0.38	28	1055	1701
September	13.3	17.64	1761	154	1.4	0.63	213	1548	1369
October	10.4	17.29	2796	743	0.74	0.87	998	1798	976
November	7.5	16.94	3832	1590	0.44	0.96	2208	1623	596
December	6	16.76	4367	2145	0.35	0.98	2883	1484	423

Dist. System Losses and Gains

Temperature adjustment [C]	0.000
Heating system control category	3
Heating system responsiveness category	3
Mean internal temperature during heating hours [C]	18.23
Mean internal temperature [C]	17.47
Additional heat emissions due to non ideal control and responsiveness [kWh/y]	1210
Gross heat emission to heated space [kWh/y]	12441

	Number present	Boiler controlled by thermostat	Inside dwelling	Electricity consumption [kWh/y]	Heat gain [W]
Central heating pumps	2	Yes	Yes	260	20
Oil boiler pumps	0	No	No	0	0
Gas boiler flue fan	0			0	
Warm air heating or fan coil radiators present	No			0	0
			Totals	260	20

Gains from fans and pumps associated with space heating system	117		
Average utilisation factor, October to May	0.91		
Useful net gain [kWh/y]	106		
Net heat emission to heated space [kWh/y]	12335		
Is there underfloor heating on the ground floor?	No	**U-Value of ground floor [W/m²K]**	0.00
Fraction of heating system output from ground floor	0.67		
Additional heat loss via envelope element	0.00		
Annual space heating requirement [kWh/y]	12335		

Energy Requirements: Individual

Efficiency of main heating system [%]		535.00
Manufacturer name	Neura	
Model name	S10	
Efficiency adjustment factor		1.0000
Adjusted efficiency of main heating system [%]		535.00
Fraction of heat from secondary system		0.10
Efficiency of secondary system [%]		70.00
Energy required for main heating system [kWh/y]		2075
Energy required for secondary heating system [kWh/y]		1777

CHP

Fraction of main space and water heat from CHP	0.00
Heat demand from CHP	0

Efficiency of main water heating system [%]		199.00
Manufacturer name	Neura	
Model name	S10	
Efficiency adjustment factor		1.0000
Adjusted efficiency of main water heating system [%]		199.00
Energy required for main water heater [kWh/y]		1562
Energy required for secondary water heater [kWh/y]		0

		Primary energy conversion factor	**CO2 emission factor**
Main space heating system	Electricity	2.19	0.473
Secondary space heating system	Wood Logs	1.1	0.025
Main water heating system	Electricity	2.19	0.473

Supplementary water heating system	None	0	0
Pumps, fans		2.19	0.473
Energy for lighting		2.19	0.473

	Comment	Type	Part L Total Contribution [kWh/y]	Delivered Energy [kWh/y]	Primary energy conversion factor	CO2 emission factor [kg/kWh]
Energy produced or saved 1	HP	Renewable Thermal	1545.900	0.000	0.00	0.000
Energy consumed by the technology 1				0.000	0.00	0.000
Energy produced or saved 2		Renewable Thermal	0.000	0.000	0.00	0.000
Energy consumed by the technology 2				0.000	0.00	0.000
Energy produced or saved 3		Renewable Thermal	0.000	0.000	0.00	0.000
Energy consumed by the technology 3				0.000	0.00	0.000

Do renewable resources meet the main space heating need?	No
Do renewable resources meet the main water heating need?	No

CHP Data

Heat output from CHP [kWh/y]	0
Electrical efficiency of CHP	0.00
Heat efficiency of CHP	0.00
CHP Fuel type	None
Energy delivered to CHP [kWh/y]	0
Electrical output from CHP [kWh/y]	0

Summer internal gains

Dwelling Volume [m³]	696.78
Effective air change rate for summer period [ac/h]	5
Ventilation heat loss coefficient [W/K]	1150
Fabric heat loss coefficient [W/K]	251
Heat loss coefficient under summer conditions [W/K]	1400
Total Solar Gains for Summer Period	0
Internal gains [W]	1090
Total gains in summer [W]	1090
Temperature increment due to gains [C]	0.8
Summer mean external temperature [C]	15.000
Heat capacity parameter	0.2
Temperature increment related to thermal mass [C]	1
Threshold internal temperature [C]	16.4

Results

	Delivered energy [kWh/y]	Primary energy [kWh/y]	CO2 emissions [kg/y]
Main space heating system	2075.10	4544.47	981.52
Secondary space heating system	1777.31	1955.05	44.43
Main water heating system	1561.99	3420.76	738.82
Supplementary water heating system	0.00	0.00	0.00
Pumps and fans	547.52	1199.06	258.98
Energy for lighting	1151.42	2521.61	544.62
CHP input (individual heating systems only)	0.00	0.00	0.00
CHP electrical output (individual heating system only)	0.00	0.00	0.00
Renewable and energy saving technologies			
Energy produced and saved	0.00	0.00	0.00
Energy consumed by the technology	0.00	0.00	0.00
Total	7113.34	13640.94	2568.37
Per m² floor area	27.64	53.00	9.98

Energy Rating	A3

LATENTO®

LATENTO all-year solar systems for DHW and back-up the heating

IVT
MEMBER OF THE WÜRTH GROUP

Contents

LATENTO solar systems

In a very few years, fossil fuels will either be exhausted or totally uneconomical to use for heat generation purposes. At the same time, every year the sun radiates an amount of energy which corresponds to about 10,000 times the world's primary energy demands, free of charge. Without question, the sun is the "fuel of the future".

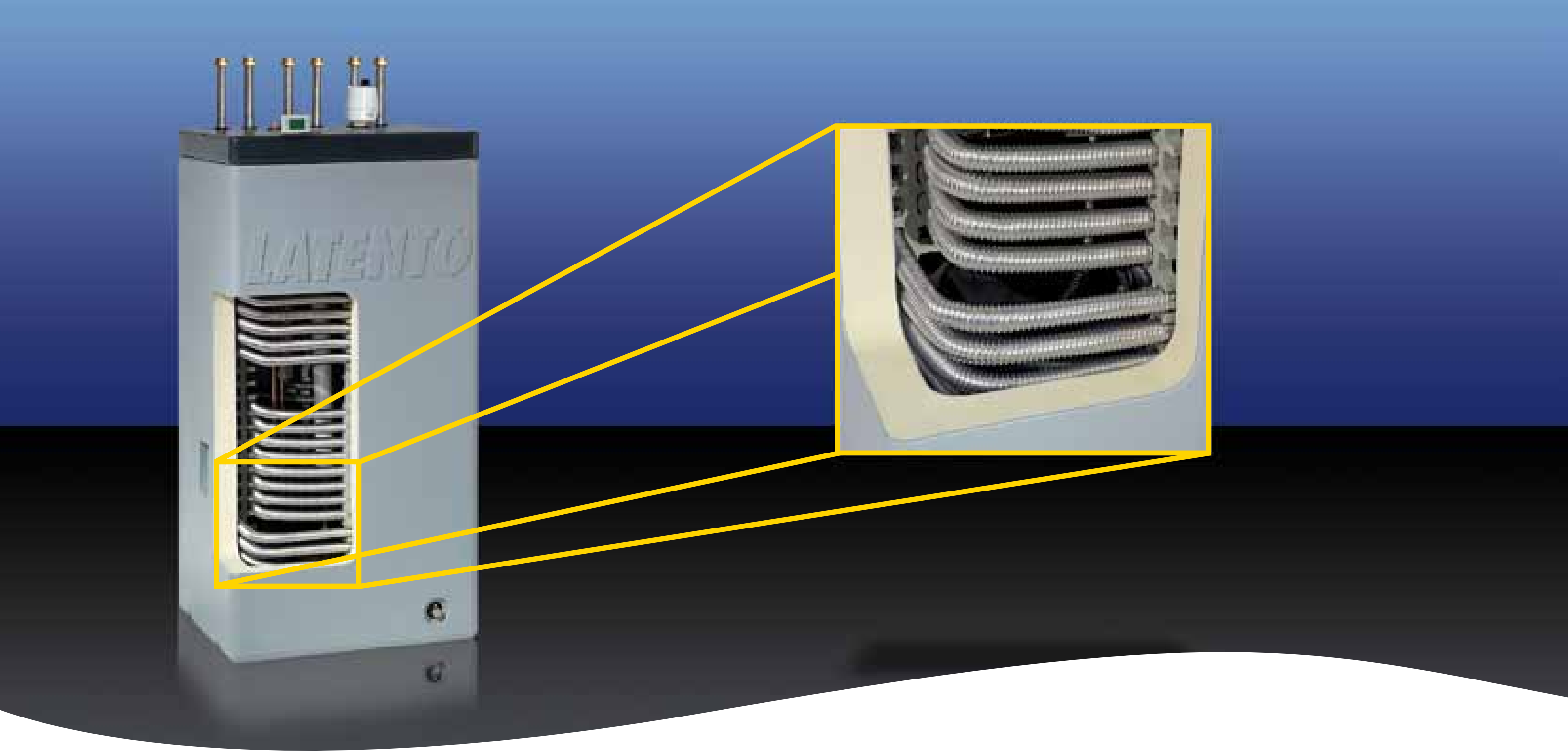
The design of modern low-energy and passive houses requiring little heat makes it possible to utilise solar energy for heating living areas as well as for pre-heating swimming pools in addition to heating for the hot water system.

Modern systems have to be compatible with fossil-fuel and regenerative fuel systems (solar, pellets, heat-pumps etc.) and ensure the existing resources are optimally usable for all energy supplies. A decisive factor in the quality of a solar system is how much annual oil or gas usage it can replace by solar energy. A ***LATENTO*** all-year solar system is the optimum solution.

An efficient solar heating system not only takes care of hot water supplies during the summer, it also converts solar energy in the winter and the transitional months. With many solar systems, however, on cool days the warmth of the sun never even reaches the solar storage because the collector promptly reflects the sun's heat it receives away again, or it loses the energy in the pipework and storage system. These "apparent" yields then have to be raised to usable temperatures with expensive supplementary energy – which is not the case with a ***LATENTO*** solar system.

It is not the size of the collector units or the storage volume which is decisive regarding the effectiveness of a solar heating system, but the efficiency of its components and how well they are tuned to the demands of the consumers. With a larger collector surface, the yield would certainly be greater, but the solar utilisation rate would deteriorate. The larger the collectors, the more frequently the system is inactive in summer – the sun delivers far more energy than residents can possibly use. Especially in winter and in the transitional periods, when supplementary heating is most in demand, a ***LATENTO*** solar system makes its mark with high solar yields and extremely low levels of heat loss.

LATENTO uses solar output large and small for heating water and utilises it even during frosty weather to supplement the heating. That means the highest possible level of efficiency for maximum solar warmth all the year round.



LATENTO$_{XXL}$

Solar layer stratified storage tank

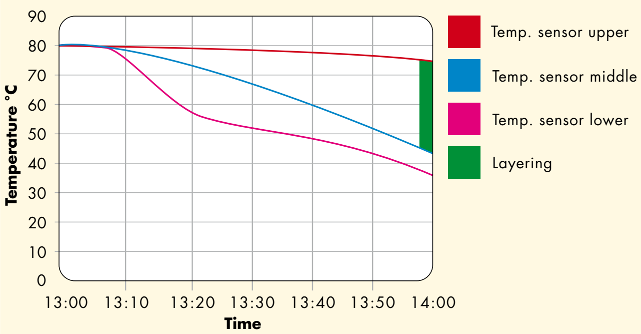
Four characteristics which make all the difference

Efficiency is the decisive factor for the effectiveness of solar thermal systems. The ***LATENTO*** stratified storage tank – the core of the ***LATENTO*** solar system – carries complete conviction with four essential characteristics which in total assure you of the best possible efficiency and thus maximum effectiveness of your solar heating system.

1. Stratification

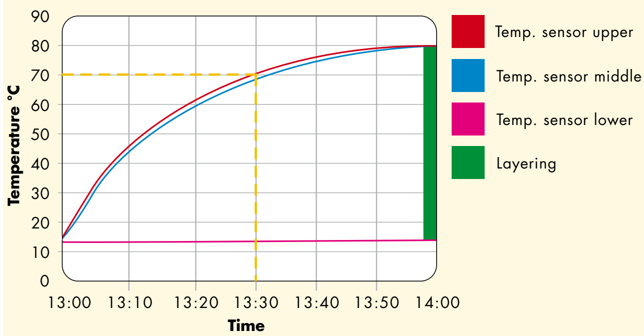
A stable stratification of the temperatures of the stored water ensures with …

… exclusive utilisation as back-up heating, that the temperature in the domestic hot water region – or the upper storage area – is maintained. The output for domestic hot water heating is additionally available all the time.



When operating as back-up heating (tapping via exchanger in the middle area), the temperature for hot water (DHW) is maintained!

… fast loading that hot water at 70 °C can be tapped after only 30 minutes of solar yield.

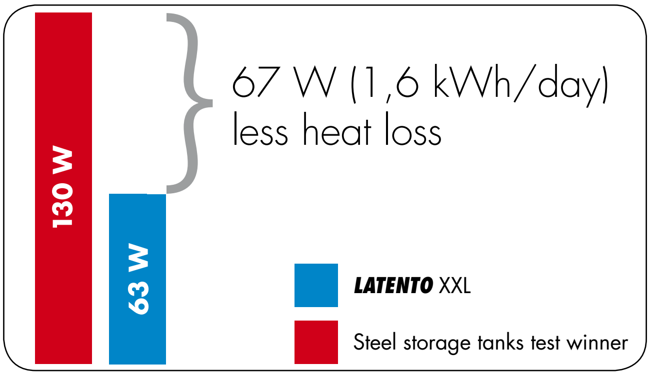


The solar area still stays cool even during back-up heating/loading, so that solar yield is still possible!

LATENTO®

2. Insulation

The ***LATENTO*** plastic storage tank is manufactured completely of insulating material (PP/PUR/PP). Conventional steel storage tanks by contrast have to be insulated additionally. Apart from this, the ***LATENTO*** has no side and bottom connections, which also lead to heat losses (heat bridges in conventional steel storage tanks). The temperature losses of 0.1 K/h are commensurately low, corresponding to a thermal power loss of 63 W. For comparison: the best steel storage tank tested by the consumer magazine Stiftung Warentest 03/2009 demonstrated a heating power loss of 130 W. This difference in heat loss can correspond to a complete day's solar yield in winter (40 l hot water).

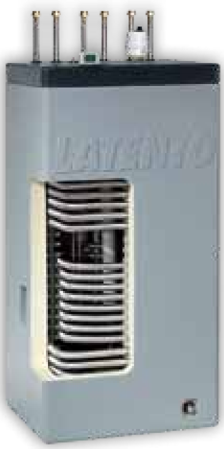


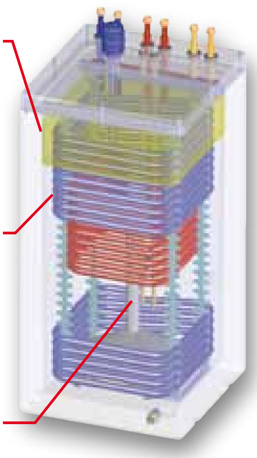
3. Output

With tapping capacity of 247 l (65 °C storage temperature, without re-heating), a continuous rating of 1220/l/h, a storage capacity of max. 54 kWh and nominal power rating of NL 7,3, the ***LATENTO*** XXL guarantees a high level of comfort and is ready to use quickly. On a sunny day, it can be ready to provide ample water for a shower after only 30 minutes' loading. To warm up the contents of a much larger storage tank to a usable temperature demands substantially more solar energy, and this just isn't always available.

4. Compactness

On account of its dimensions of only 78 x 78 x 158 cm (standing area 0.64 m², diagonal measurement 1.76 cm), the ***LATENTO*** is ideal for refurbishing old buildings and for installation in small spaces. Thanks to this compactness and the integral carrying handles, the ***LATENTO*** is no problem for transport and negotiates all standard sizes of doors.





Further advantages of the LATENTO stratified storage tank

- The design of the DHW heat exchanger caters for pre-heating of the drinking water and cools down the lower storage area. Even when the solar yield is low, the ***LATENTO*** installation starts to work.
- Storage usable up to 85 °C
- Latent material for additionally increased output as "storage turbo"
- Digital temperature and water-gauges
- The ***LATENTO*** is the first solar storage tank to be awarded the "Blue Angel" badge of environmental excellence on account of its energy efficiency.

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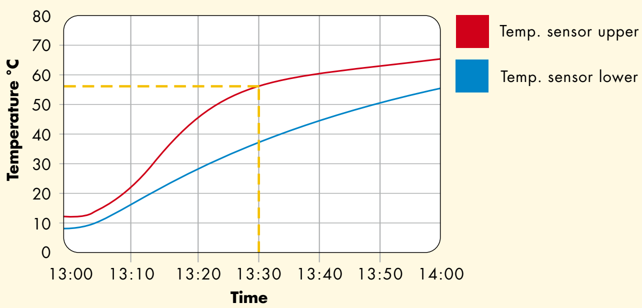
LATENTO$_{XW}$

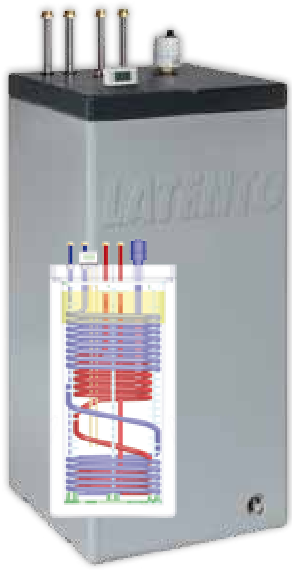
Hot water storage tank

LATENTO XW loading



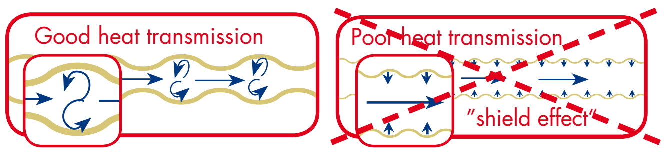
After only 30 minutes' loading* there is already a usable temperature of 50°C available.

*Loading rate 22 kW



The ***LATENTO*** XW hot water storage tank works on the continuous-flow heater principle and has heating and discharge heat exchangers of long-wave stainless steel corrugated pipes for a very high continuous rating of 1.350 l/h (at 85 °C re-heating), a tapping capacity of 277 l (65 °C storage temperature, without re-heating) and a storage capacity of max. 54 kWh*. In addition, the heat loss is absolutely marginal. The ***LATENTO*** XW is suitable for combination with all heat generators – solar as well. Storage temperature and contents are shown by means of a digital display.

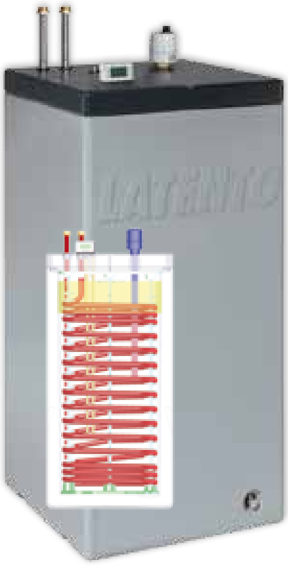
A ***LATENTO*** installation on the roof of the Playmobil Funpark on Malta



All heat exchangers are manufactured with long-wave stainless steel corrugated pipes for improved heat yield. This discourages the "shield effect" (flow-past) which is experienced with a narrow-waveband pipe.

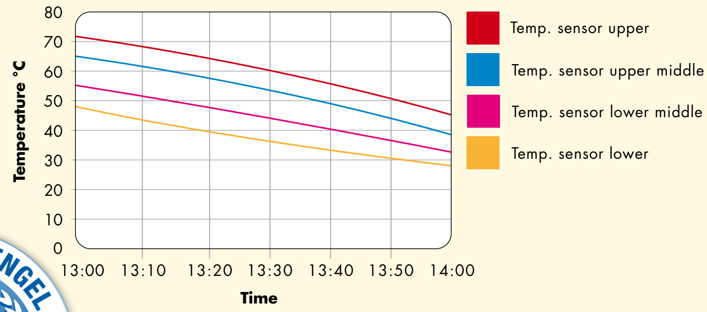
* All values as per DIN 4708 ITW (University of Stuttgart/Germany)

LATENTO$_{XP}$
Unpressurised buffer storage tank



Our buffer storage for long-term heat storage. The XP has a large heat exchanger of long-wave stainless steel pipe for very good heat transmission. Its insulating plastic tank loses virtually no stored heat (0.1 K/h). Latent material makes sure of an additional output. Storage temperature and contents are shown by means of a digital display.

LATENTO XP tapping with 35°C (VL) with approx. 14 kW tapping power



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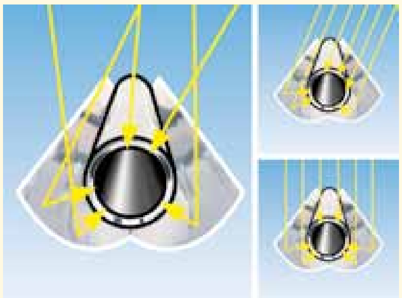
Output figures ***LATENTO*** XP	ΔT = 5 K	ΔT = 10 K	ΔT = 35 K
Exchanger output	15 kW	25 kW	50 kW

These advantages apply to all LATENTO storage tanks:

- High-quality tank insulation means the best possible efficiency
- Compact design
- Heat exchanger of long-wave stainless steel corrugated pipe for improved heat yield (no "shield effect" which is experienced with a narrow-waveband pipe)
- Output improved by the addition of latent material ("storage turbo")
- Fresh water principle (no bacterial growth, legionella formation) – hygienically optimal (the continuous-flow water heater principle gives legionella no chance)
- Digital temperature and content display
- Light and easy to handle
- Integrated carrying handles and belt grooves to simplify transport
- Ready to connect
- Easy to install with the connections arranged close to the wall
- Maintenance-free and does not corrode
- Maximum utilisation of volume
- Attractive design
- More than ten years' experience with plastic storage tanks

CPC 12/CPC 18
Solar collectors

Angle of incidence



Even at unfavourable angles of incidence, both direct and diffuse sunlight are optimally directed to the absorber thanks to the mirror geometry.

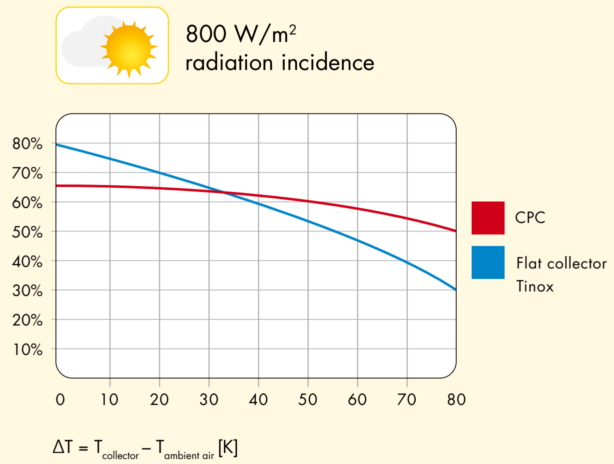
The ***LATENTO*** vacuum tube collectors perform convincingly at all times, having a very low heat loss and thus a very high efficiency, resulting in high solar yields even in transitional and winter months.

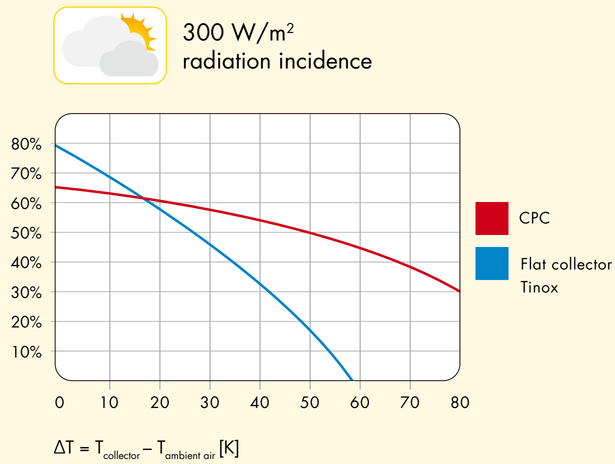
A highly-reflective, weather-resistant CPC mirror makes sure that the sun's rays from almost every direction and even at unfavourable angles of incidence are directed onto the absorber. Arrangement of the vacuum tubes to face in a particular direction is not necessary.

What you can expect from IVT solar collectors:

- very fast reaction times
- almost loss-free (< 6 %)
- resistant to weather and ageing
- high performance even on cool days
- easy to install
- fracture-resistant (for example hail)
- "Made in Germany"
- "Solar Keymark" (DIN tested)

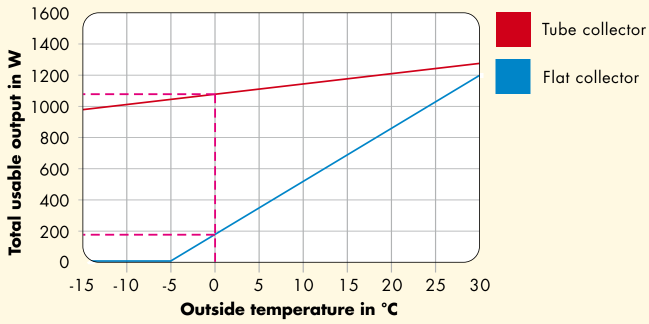
Comparison of the efficiency curves of the CPC collector and a flat collector





The vacuum of the CPC tube collectors (thermos-flask principle) ensures a low rate of heat radiation and thus a high rate of efficiency, above all on days when ambient temperatures are low or the sun's radiation is diffuse – in other words, at all times when heating support is needed.

Comparison of the output of a CPC vacuum pipe collector with a flat collector



Example: output of a 7 m² collector area on an average January day (300 W solar radiation and 0 °C outside temperature)

- The flat collector (efficiency approx. 10 %) achieves a usable output of about 0.2 kW
- The tube collector (efficiency approx. 50 %) achieves a usable output of about 1 kW

On an average January day, taking Würzburg as our example, with approx. 0 °C outside temperature and 300 W/m² radiation intensity, the CPC tube collector with 7 m² collector area achieves over 1,000 W of usable output, and the flat collector just 200 W. Increasing the collector area does not lead to higher temperatures and thus a better yield.

Connections
Speed/Fix

Our fully-insulated connections are designed for maximum solar yield. Please note, however, that for the best possible yields it is necessary to install optimal insulation over the whole of the solar lead from the collector to the storage tank. Take care to avoid those insulation gaps which swallow up solar yield.

The Speed CPC connection set provides for a quick and simple connection from the collector. It consists of flexible stainless steel corrugated pipe with high temperature- and weather-resistant heat insulation.

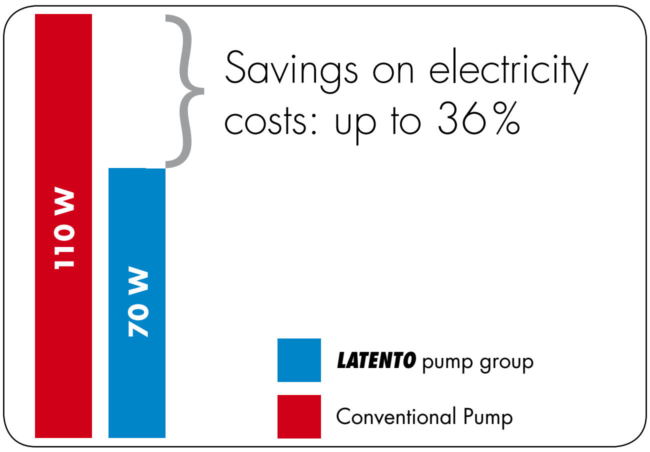
The matching quickly-fitted pipework system for complete insulation of the connection of pump group and vacuum tube collector consists of soft copper pipe (18 x 0.8 mm or 18 x 1 mm) or stainless steel corrugated pipe DN 16 or DN 20. A silicone sensor cable is integrated into the system. The insulation is designed using high-temperature resistant EPDM rubber foam.

Pump groups

The ***LATENTO*** solar heating system works with completely-insulated solar pump groups with integrated permanent vent for continuous removal of micro-bubbles in the solar circulation. This facilitates venting at the pump group.

Speed of the pump is infinitely variable according to output, and this means the pump group lasts longer and it saves electricity.

Using a ***LATENTO*** pump group, the maximum power drawn is 70 watts. Compared with a conventional 110 W pump, this solution saves up to 36 % of electricity costs.



Tip: expansion vessels

We recommend that expansion vessels are included in the design, as per DIN 4757 standards, to guarantee the safety of the solar heating system itself. The expansion vessels in the ***LATENTO*** system are deliberately generously dimensioned. This is often not the case in traditional systems, and this can lead to system malfunctions due to overheating or evaporation of the solar fluid in the installation. ***LATENTO*** expansion vessels prevent damage occurring to the system when it is not working.

Example: for a 7 m^2 collector area, we recommend a 50-litre expansion vessel.

Regulation

Pump group with solar regulation:

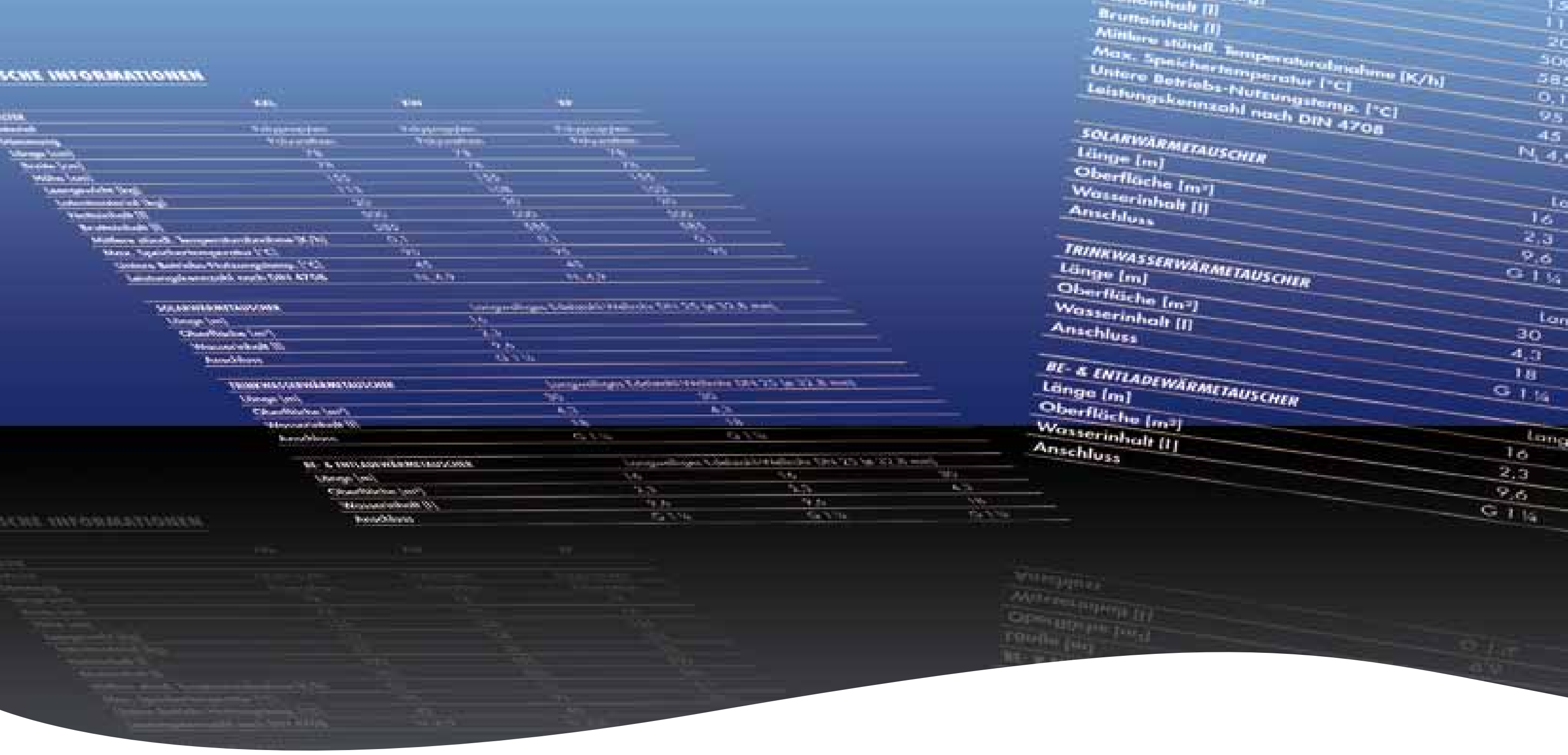
- Solar regulation
- Ideal for retro-fitting existing heating systems
- With gauge displaying solar yield

Solar regulation XXL:

- Solar regulation with buffer-storage management
- Swimming baths can also be integrated
- Ideal for extending an existing heating system (extended version)
- With gauge displaying solar yield

All-inclusive regulation:

- Solar- and heating controls
- Individually programmed regulation for convenience
- Control of a number of heat generators according to priority (regenerative first)
- Room temperature control possible in conjunction with remote controls
- Master regulation for complete installations
- Individually pre-programmed



Technical data

Vacuum tube collector	**CPC 12**	**CPC 18**
Number of vacuum tubes	12	18
Width x height [m]	1.64x0.105	
Length [m]	1.39	2.08
Gross area [m^2]	2.28	3.41
Aperture area [m^2]	2.0	3.0
Absorber area [m^2]	2.0	3.0
Collector capacity [l]	1.5	2.4
Weight approx. [kg]	37	54
Max. perm. operating press. [bar]	10	
Colour	grey, RAL 7015	
Glass material	Borosilicate 3.3	
Glass tube diameter [mm]	47	
Wall thickness [mm]	1.6	
Vacuum	long-term stable 10^{-6} mbar	
Absorber material	Aluminium	
Coating	Aluminium nitrite	
Optical efficiency	C0: 0.642	
Loss factor C1 [$W/m^2 K$]	0.885	
Loss factor C2 [$W/m^2 K^2$]	0.001	
Setting angle [°]	15–90	
Admissible working pressure [bar]	10	
Connection	Threaded clamping ring	

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Storage tank	XXL	XW	XP
CONTAINER			
Material	Polypropylene		
Insulation	Polyurethane		
Length [cm]	78	78	78
Width [cm]	78	78	78
Height [cm]	158	158	158
Diagonal measurement	176	176	176
Weight empty [kg]	98	92	88
Latent material [kg]	20	20	20
Net content [l]	500	500	500
Gross capacity [l]	536	536	536
Average hourly temperature loss [K/h]	0.1	0.1	0.1
Max. storage temperature [°C]	85	85	85
Tapping rating [l] (65 °C storage temperature) without re-heating	247	277	
Continuous rating [l/h] (85 °C re-heating)	1220	1350	
Max. storage capacity [kWh]	54	54	54
Nominal power rating N_L*	N_L 7.3	N_L 11.5	
Continuous power Q_D 85/10/45 (kW)	50	55	
SOLAR HEAT EXCHANGER	Long-wave stainless steel corrugated pipe DN 25 (ø 32.8x0.3 mm)		
Length [m]	14		
Surface area [m²]	2.2		
Water content [l]	9.8		
Connection	G 1 ¼		
DRINKING WATER HEAT EXCHANGER	Long-wave stainless steel corrugated pipe DN 25 (ø 32.8x0.3 mm)		
Length [m]	29.1	31.2	
Surface area [m²]	4.2	4.5	
Water content [l]	20,5	21,7	
Connection	G 1 ¼	G 1 ¼	
HEATING & DISCHARGE HEAT EXCHANGER	Long-wave stainless steel corrugated pipe DN 25 (ø 32.8x0.3 mm)		
Length [m]	15,8	19.5	33.5
Surface area [m²]	2.3	2.8	4.8
Water content [l]	11.0	13.6	23.5
Connection	G 1 ¼	G 1 ¼	G 1 ¼

* as per DIN 4708-3 (heating rate 60 kW) ITW ((University of Stuttgart/Germany)

About the company

IVT (Installations- und Verbindungstechnik GmbH & Co. KG) is known internationally for innovative products in the fields of plumbing and heating engineering. Founded in 1994, the company which is a partner of the globally-active Wurth Group uses modern extrusion plants to manufacture PE-X pipes for drinking water pipework, radiator connection systems and surface heating systems.

In 2001, the unpressurised Latento solar layered storage tank also came from IVT's research and development department. The plastic storage tank set standards in the field of efficient solar energy storage, and in 2006 as the first solar energy storage had the honour of the "Blue Angel" environmental award bestowed on it.

With its system solutions for drinking water installations and their radiator connection systems and surface heating systems, the ***PRINETO*** plastic pipe system is the ideal complement to a ***LATENTO*** all-year-round solar heating installation.

IVT's company philosophy is the realisation of innovations of a high technical standard. Many years of experience in the field of plastics engineering and numerous national and international references bear witness to the high quality of IVT products.

A brief portrait

Since its formation in 1994, IVT has grown continuously. It has 115 employees at home and abroad, annual sales amounting to some 30 million euro, and IVT has modern manufacturing facilities at its headquarters in Rohr, near Nuremberg and realises major national and international projects.

Business activities are concentrated on innovative solutions for sanitary and heating systems, which are well-known under the brand names of ***PRINETO***, ***NANOTEC*** and ***LATENTO***.

LATENTO®

References

There are already more than 1,000 ***LATENTO*** solar heating systems installed all over the world in various types of property (single- and multiple-occupancy houses, industrial buildings, hotels etc.), and the numbers are increasing all the time. Well-known developers and building sponsors as well as many installation and industrial concerns who set great store by quality and service are happy to rely on ***LATENTO*** all-year-round solar systems.

House in Madrid, Spain

Hotel Neubrandenburg, Germany

House in Peking, China

House in Nuremberg, Germany

Furniture store in Brisbane, Australia

Leisure park in Malta

LATENTO®

LATENTO Solar heating systems efficient down to the last detail

A highly-efficient solar heating system is only created by consistently maintaining essential efficiency criteria in all components and by their perfect interaction. As a complete system, the ***LATENTO*** all-year solar heating system, with all its carefully-thought-out detail solutions, takes care of highly-efficient utilisation of solar energy for heating water and for supporting heating systems – throughout the whole year.

Your ***LATENTO*** system supplier

E&OE; subject also to technical modifications!

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D - 91189 Rohr
Hotline +49 9876 9786 97
Fax +49 9876 9786 98
info@ivt-rohr.de • www.ivt-rohr.de

IVT
MEMBER OF THE WÜRTH GROUP

Technical Document:

according to directive 2010/30/EU and corresponding regulation (EU) No. 811/2013 (Energy Labelling)
according to dircetive 2009/125/EC and corresponding regulation (EU) No. 813/2013 (Ecodesign)

Heat pump name:	S10EuC
Heat pump type:	NDB
Temperature niveau:	35°C / 55°C
With backup heater:	No
Is combi heater:	No

Manufacturer:	NEURA AG
Street / Number	Seestraße 8
Country / ZIP / City	AT 4844 Regau

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This document contains non measured values.

Power control mode	fixed	
SPL indoor	-	dBA
SPL outdoor	54,0	dBA

Source ṁ	2,18	m³/h

POff	0	W
PTO	28	W
PSB	28	W
PCK	0	W

Psup	0,00	kW
Type of heat contribution	E-heater	

Hot water profile	-	
QElec	-	kWh

ηWH	-	%
ACE	-	kWh

Tbiv	2	°C
Tbiv	-10	°C
Tbiv	-22	°C

TOL	-22	°C
WTOL	62	°C

Parameters are indicated for warmer climate:											
QHE										2915,38	kWh
Low temperature application 35°C						Medium temperatur application 55°C					
Prated	9,92	kW	ηS	174,0	%	Prated	8,86	kW	ηS	128,0	%
Pdh 2°C	9,92	kW	COPd 2°C	4,33	-	Pdh 2°C	8,86	kW	COPd 2°C	2,44	-
Pdh 7°C	10,04	kW	COPd 7°C	4,54	-	Pdh 7°C	9,24	kW	COPd 7°C	3,11	-
Pdh 12°C	10,21	kW	COPd 12°C	4,85	-	Pdh 12°C	9,77	kW	COPd 12°C	4,06	-
Pdh Tbiv	9,92	kW	COPd Tbiv	4,33	-	Pdh Tbiv	8,86	kW	COPd Tbiv	2,44	-
Pdh Tdesign	9,92	kW	COPd Tdesign	4,33	-	Pdh Tdesign	8,86	kW	COPd Tdesign	2,44	-

Technical Document:

Heat pump name:	S10EuC
Heat pump type:	NDB
Temperature niveau:	35°C / 55°C
With backup heater:	No
Is combi heater:	No

Parameters are indicated for average climate:											
QHE										4506,66	kWh
Low temperature application 35°C						Medium temperatur application 55°C					
Prated	9,92	kW	ηS	174,0	%	Prated	8,86	kW	ηS	128,0	%
Pdh -7°C	9,94	kW	COPd -7°C	4,37	-	Pdh -7°C	8,99	kW	COPd -7°C	2,67	-
Pdh 2°C	10,06	kW	COPd 2°C	4,59	-	Pdh 2°C	9,41	kW	COPd 2°C	3,43	-
Pdh 7°C	10,17	kW	COPd 7°C	4,78	-	Pdh 7°C	9,68	kW	COPd 7°C	3,90	-
Pdh 12°C	10,29	kW	COPd 12°C	4,98	-	Pdh 12°C	9,95	kW	COPd 12°C	4,38	-
Pdh Tbiv	9,92	kW	COPd Tbiv	4,33	-	Pdh Tbiv	8,86	kW	COPd Tbiv	2,44	-
Pdh Tdesign	9,92	kW	COPd Tdesign	4,33	-	Pdh Tdesign	8,86	kW	COPd Tdesign	2,44	-

Parameters are indicated for colder climate:											
QHE										5289,75	kWh
Low temperature application 35°C						Medium temperatur application 55°C					
Prated	9,92	kW	ηS	177,0	%	Prated	8,86	kW	ηS	132,0	%
Pdh -15°C	8,09	kW	COPd -15°C	4,53	-	Pdh -15°C	9,12	kW	COPd -15°C	2,91	-
Pdh -7°C	10,08	kW	COPd -7°C	4,62	-	Pdh -7°C	9,33	kW	COPd -7°C	3,28	-
Pdh 2°C	10,18	kW	COPd 2°C	4,79	-	Pdh 2°C	9,63	kW	COPd 2°C	3,81	-
Pdh 7°C	10,25	kW	COPd 7°C	4,92	-	Pdh 7°C	9,86	kW	COPd 7°C	4,22	-
Pdh 12°C	10,28	kW	COPd 12°C	4,98	-	Pdh 12°C	10,05	kW	COPd 12°C	4,56	-
Pdh Tbiv	9,92	kW	COPd Tbiv	4,33	-	Pdh Tbiv	8,86	kW	COPd Tbiv	2,44	-
Pdh Tdesign	9,92	kW	COPd Tdesign	4,33	-	Pdh Tdesign	8,86	kW	COPd Tdesign	2,44	-

Technical Document:

Heat pump name:	S10EuC
Heat pump type:	NDB
Temperature niveau:	35°C / 55°C
With backup heater:	No
Is combi heater:	No

Parameters are indicated for warmer climate:

Low temperature application 35°C			Medium temperatur application 55°C		
CC 2°C	0,988	-	CC 2°C	0,992	-
CC 7°C	0,987	-	CC 7°C	0,991	-
CC 12°C	0,987	-	CC 12°C	0,988	-
CC Tbiv	0,988	-	CC Tbiv	0,992	-
CC Tdesign	0,988	-	CC Tdesign	0,992	-

Parameters are indicated for average climate:

Low temperature application 35°C			Medium temperatur application 55°C		
CC -7°C	0,988	-	CC -7°C	0,992	-
CC 2°C	0,987	-	CC 2°C	0,990	-
CC 7°C	0,987	-	CC 7°C	0,989	-
CC 12°C	0,986	-	CC 12°C	0,988	-
CC Tbiv	0,988	-	CC Tbiv	0,992	-
CC Tdesign	0,988	-	CC Tdesign	0,992	-

Parameters are indicated for colder climate:

Low temperature application 35°C			Medium temperatur application 55°C		
CC -15°C	0,987	-	CC -15°C	0,991	-
CC -7°C	0,987	-	CC -7°C	0,990	-
CC 2°C	0,987	-	CC 2°C	0,989	-
CC 7°C	0,987	-	CC 7°C	0,988	-
CC 12°C	0,986	-	CC 12°C	0,987	-
CC Tbiv	0,988	-	CC Tbiv	0,992	-
CC Tdesign	0,988	-	CC Tdesign	0,992	-