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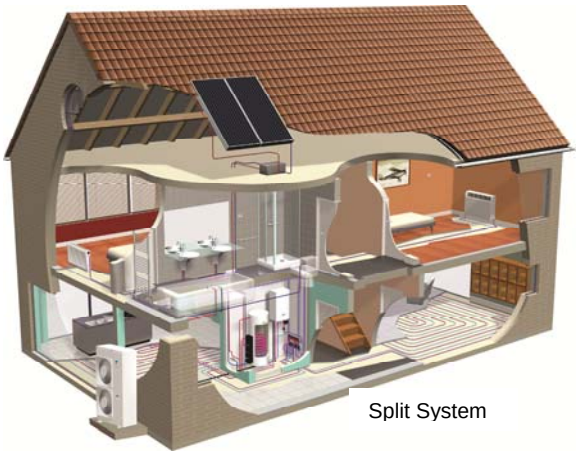
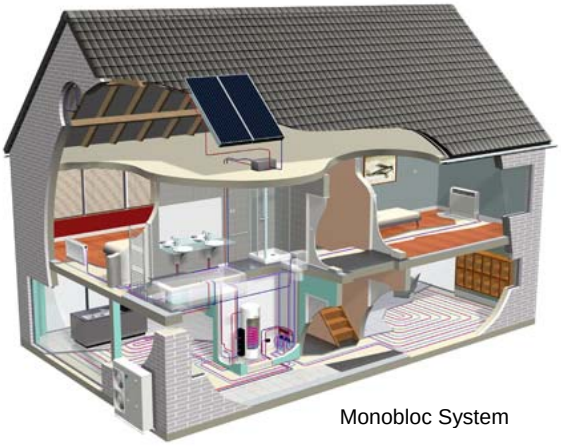
Daikin Altherma™ (Air-to-Water Heat Pump Hydronic System)

Energy Efficient and Innovative Solution

A Residential System that Heats, Cools and supplies Domestic Hot Water.



Split System



Monobloc System

Produced by the Residential Solution Sales Division.
Daikin AC Americas, Inc.

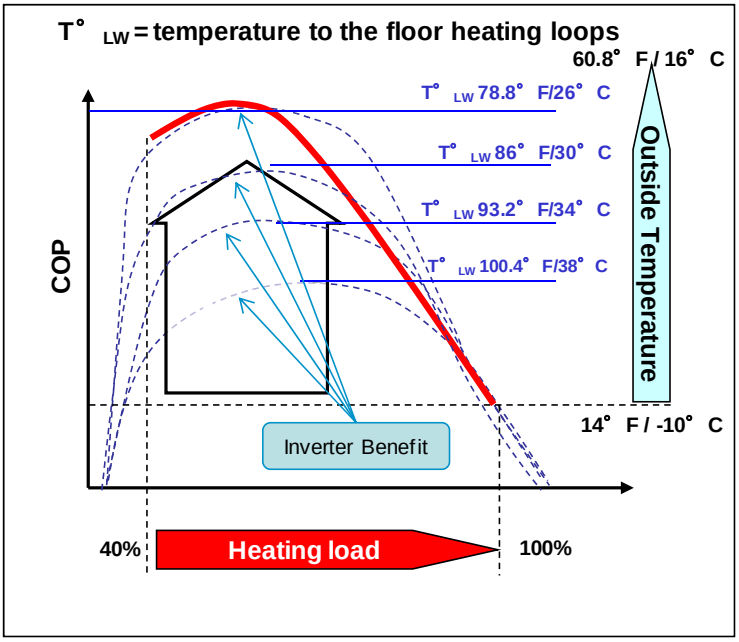
A ground breaking product that combines specialized components to provide the hydronic industry with an integrated solution for heating, cooling and domestic hot water with solar thermal options. This is accomplished by using a heat pump to heat water for space heating and domestic hot water, using the reverse cycle to chill water for cooling.

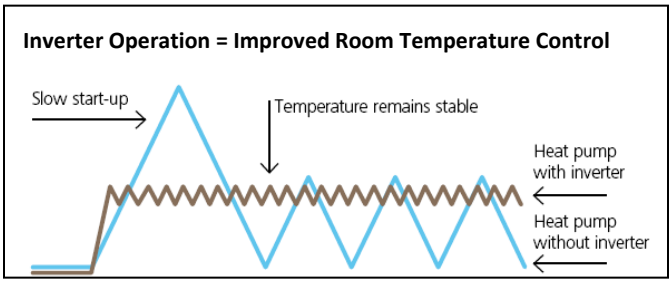
Introduction – What is Daikin Altherma?

Daikin Altherma is an eco-efficient air-to-water heat pump single hydronic system that produces heating loop water temperatures of 86°F to 131°F (30°C to 55°C). It extracts heat from a renewable and natural energy source, the outside air, and transfers it through refrigerant piping to a hydrobox. The hydrobox heats water through a brazed plate heat exchanger (refrigerant-to-water) that circulates through floor heating systems, fan coil units, low temperature radiators and also provides domestic hot water (DHW). The combination heating and cooling model can reverse the cycle to provide chilled water for cooling (41°F/5°C to 72°F/22°C).

Daikin Altherma with its variable speed inverter driven compressor provides a high level of comfort by allowing multiple zoning and by matching individual zone demands while achieving efficient full load operation (COP=2 to 5, EER=9 to 12+). This system is very quiet (49 dBA-sound pressure heating mode as compared to normal conversational speech-50dBA) and does not intrude on the inside and outside aesthetics of the home.

Inverter control in combination with weather dependant (outdoor reset) control results in excellent efficiencies (COP's).

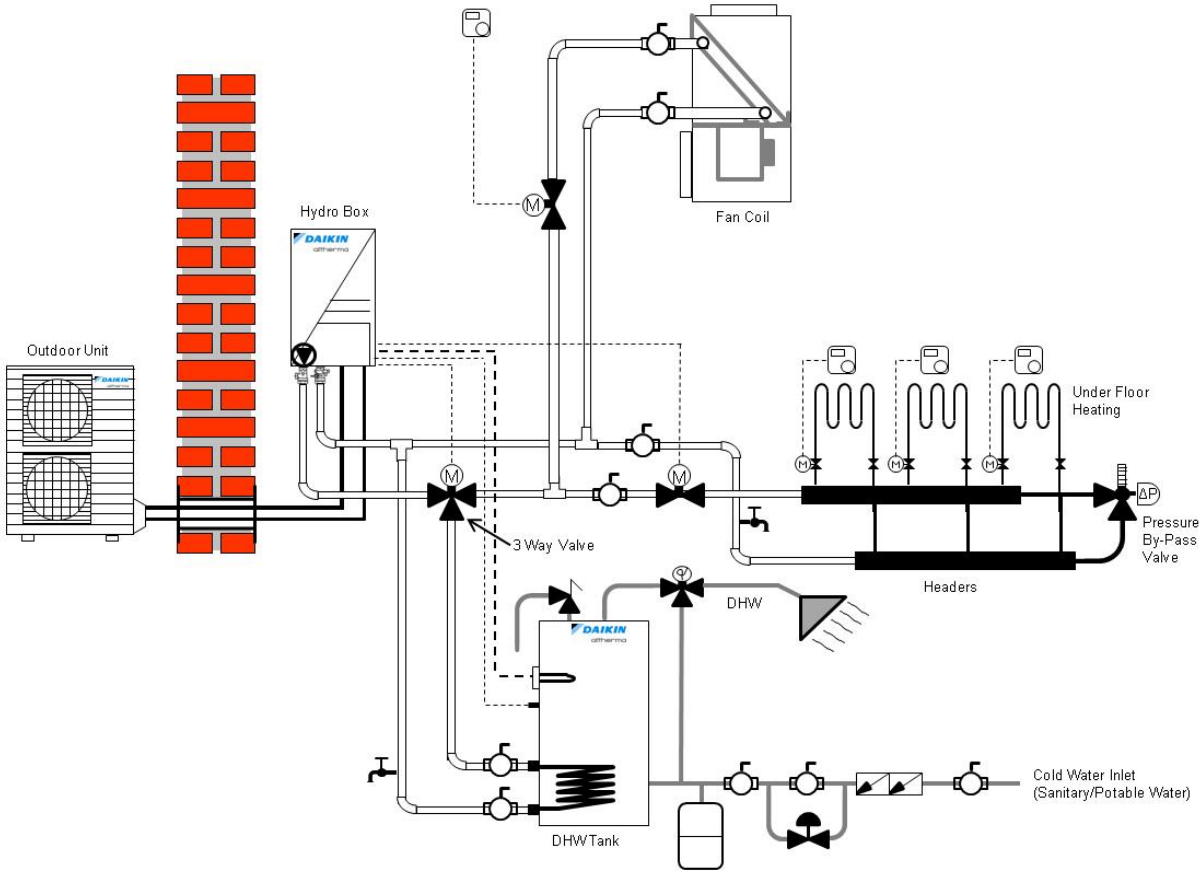




- **Maximum <u>efficiency</u> by controlling the compressor RPM, for adapting output and requirements.**
- **Maximum <u>comfort</u> under all conditions, including stable room temperatures**
- **Soft start-up (less than 5 Amps)**
- **Increased operating life, due to continuous partial-load operations**

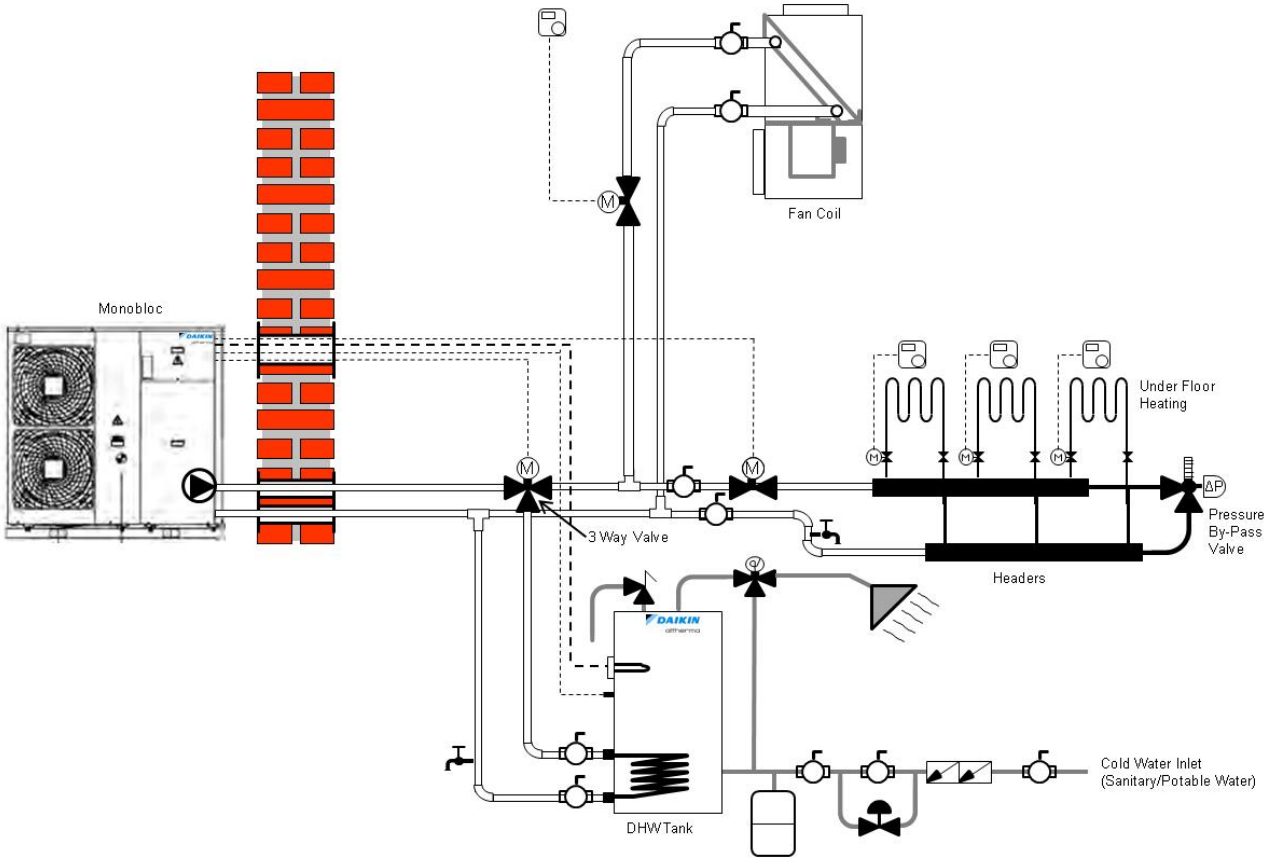
System Options

Daikin Altherma Split System



Type	Detail	Model Name
Split LT Altherma (Small Capacity)	OD Unit (Split, 5kW, Nominal 18MBH)	ERLQ018BAVJU
	OD Unit (Split, 7kW, Nominal 24MBH)	ERLQ024BAVJU
	OD Unit (Split, 9kW, Nominal 30MBH)	ERLQ030BAVJU
Hydrobox (Small Capacity)	Hydrobox (Heat Only, Back Up Heater 3kW)	EKHBH030BA3VJU
	Hydrobox (Heat Only, Back Up Heater 6kW)	EKHBH030BA6VJU
	Hydrobox (Heat Pump, Back UP Heater 3 kW)	EKHBX030BA3VJU
	Hydrobox (Heat Pump, Back Up Heater 6kW)	EKHBX030BA6VJU
Split LT Altherma (Large Capacity)	OD Unit (Split, 11kW, Nominal 36MBH)	ERLQ036BAVJU
	OD Unit (Split, 14kW, Nominal 48MBH)	ERLQ048BAVJU
	OD Unit (Split, 16kW, Nominal 54MBH)	ERLQ054BAVJU
Hydrobox (Large Capacity)	Hydrobox (Heat Only, Back Up Heater 3kW)	EKHBH054BA3VJU
	Hydrobox (Heat Only, Back Up Heater 6kW)	EKHBH054BA6VJU
	Hydrobox (Heat Pump, Back UP Heater 3 kW)	EKHBX054BA3VJU
	Hydrobox (Heat Pump, Back Up Heater 6kW)	EKHBX054BA6VJU

Daikin Altherma Monobloc System



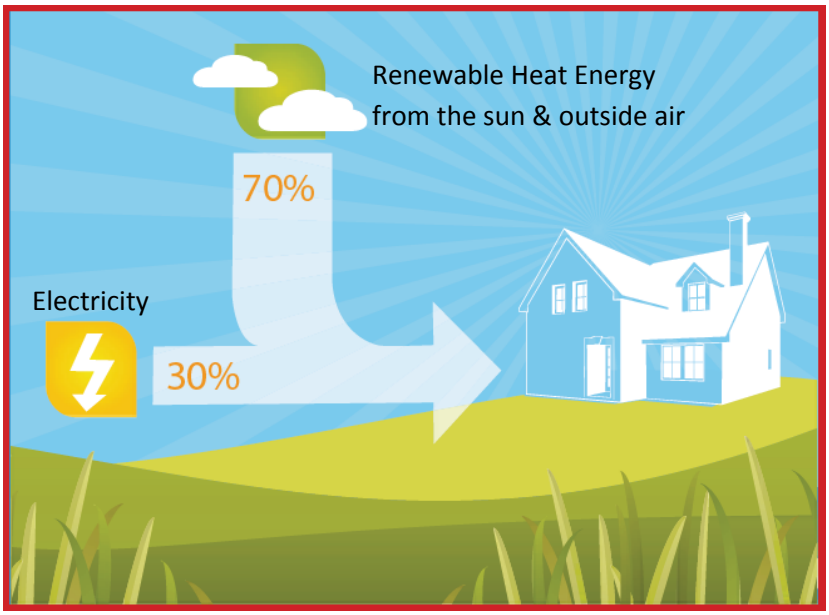
Type	Detail	Model Name
MonoBloc LT Altherma	OD Unit (Mono, Heat Only, 11kW, Nominal 36MBH)	EDLQ036BA6VJU
	OD Unit (Mono, Heat Only, 14kW, Nominal 48MBH)	EDLQ048BA6VJU
	OD Unit (Mono, Heat Only, 16kW, Nominal 54MBH)	EDLQ054BA6VJU
	OD Unit (Mono, Heat Pump, 11kW, Nominal 36MBH)	EBLQ036BA6VJU
	OD Unit (Mono, Heat Pump, 14kW, Nominal 48MBH)	EBLQ048BA6VJU
	OD Unit (Mono, Heat Pump, 16kW, Nominal 54MBH)	EBLQ054BA6VJU

Why a Heat Pump?

Heat pumps are considered the most energy efficient, electrically operated heating and cooling system on the market today. Daikin Altherma air-to-water heat pump delivers between 3 to 5 kWh of usable heat for every 1 kWh of electricity it uses. This equates to a Coefficient of Performance (COP) of 3 to 5 or 300% to 500% more efficient than resistance electric heat. Heat pumps use renewable energy sources such as the outside air and have no localized CO_2 emissions.

- Typically draws approximately 1/3 to 1/4 of the electricity of a standard resistance heater for the same amount of heating, reducing utility bills. This typical efficiency (300% to 400%) compares to 70-95% for a fossil fuel-powered boiler (fuel oil and gas).

- As an electric system, no flammable or potentially asphyxiating fuel is used at the point of heating, reducing the potential danger to users, and removing the need to obtain gas or fuel supplies.
- The convenience of a single monthly utility invoice for your heating, cooling and hot water needs.
- May be used to heat water for space heating and domestic hot water (DHW) and can be used to chill water for space cooling.
- The same system may be used for air conditioning in summer, heating system in winter as well as heating DHW.
- Daikin Altherma with inverter technology to run a variable speed compressor reduces cycle losses, and turn down ratio of 7 to 10 adds comfort by load matching. It also saves electricity and extends the life of the compressor.
- When compared to geothermal, there is no expensive drilling or excavation work resulting in a small footprint outdoors. The cost of drilling or excavating can run anywhere from $10,000 to $30,000, or more depending on the terrain and other local factors (i.e. soil analysis).
- Improved installation with no need for combustion air ventilation, combustion gas evacuation (flue), no gas supply or storage tank for fuel oil.



Example

The electrical (power) input to serve a 10kW electric resistance heat can produce at best case 34,130Btu/hr of Heat (based on COP of 1).

For the equivalent electrical input, an Altherma ERLQ036 with EKHBX054 produces 35,300Btu/hr of Heat (based on 45°F Ambient, 113°F LWT) – thus COP of 3.26)

Why Hydronic Heating and Chilled Water Cooling?

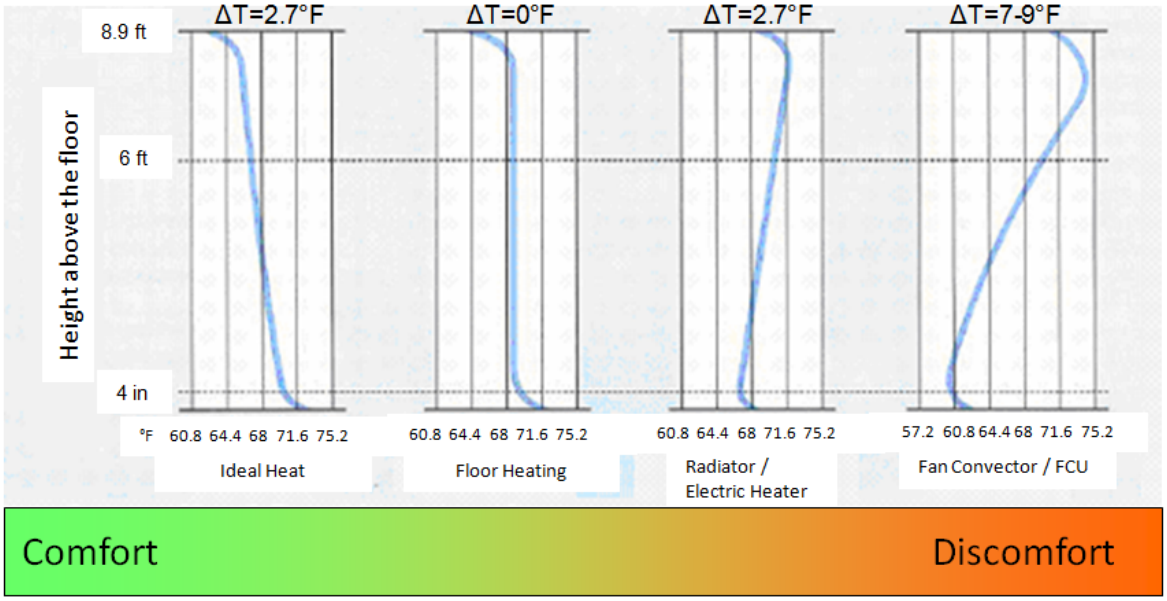
Hydronic heating and chilled water cooling systems use water transported through piping to condition the air temperature inside a residence and heat DHW.

A Daikin Altherma heat pump can accomplish all three functions. With hundreds of possible system configurations, the proper design is capable of meeting the exact comfort needs of its owner. Some systems using Daikin Altherma may be as simple as a heating only application connected to a loop of flexible plastic tubing that warms the floor. Others may use Daikin Altherma connected to an assortment of heat emitters like low temperatures radiators, fan coil units, or radiant in floor. Those same applications can also provide a residence with domestic hot water and chilled water for cooling.

Typical Characteristics of Hydronic Systems

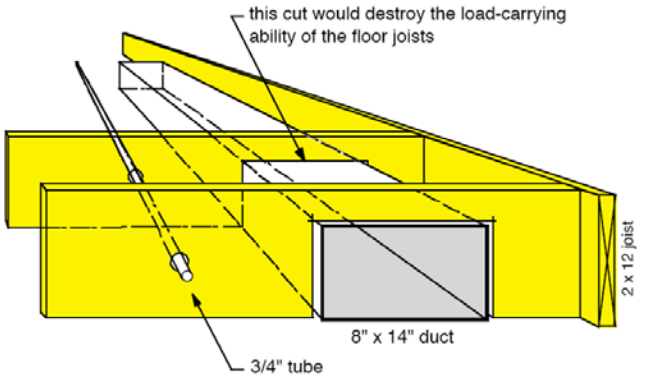
- Superior comfort: Hydronic heating has long been respected for its ability to provide excellent thermal comfort.

- Room Temperature Profile Comparison: -



Data taken from Daikin House located in Ostend, Belgium

- The best level of comfort can be achieved with an “in floor” radiant heating application and this added comfort allows the room set-point condition to be reduced by up to 3.6F versus alternative means of heating.
- Daikin Altherma can produce 41°F chilled water for cooling improving humidity control in humid climates.
- Unobtrusive installation: Hydronic heating and chilled water cooling has the ability to be installed without major modifications to the home structure. Water can absorb over 3400 times more heat (heat capacity of H_2O=62.4 Btu/ft^3/°F; heat capacity of Air=0.018 Btu/ft^3/°F; 63.4/0.018=3467) as the same volume of air for the same temperature change. This allows smaller pipes to be routed through the home instead of large ducts (see example below).



(Source: Modern Hydronic Heating 2nd Ed., ©Copyright 2004 Delmar Publishing)

- Design Flexibility: Hydronic heating offers almost unlimited possibilities to accommodate the comfort needs, usage, aesthetic tastes, and budget constraints of just about any home. Daikin Altherma allows the combination of space heating, space cooling and supply DHW with a single system.
- Clean Operation (inside and outside the home): A major complaint from home owners of whole house heating and cooling systems is the amount of dust and other airborne pollutants their systems distribute through the house. Using radiant heat emitters, heat is distributed by natural convection. Even using individual room fan powered heat convectors reduces the amount of dust and pollutants circulated through the entire house.
- Quiet Operation: A properly installed hydronic system can operate with very low sound levels in the occupied areas of a home. Low temperature (86°F/30°C to 131°F/55°C) hydronic systems can all but eliminate the expansion noises of piping associated with some high temperature hydronic systems. Individual zone fan convectors, because of their size and low air flow, are quiet. Outdoor heat pump unit is quiet due to inverter driven compressor; the majority of the time the system is operating on lower capacity (can be less than 45 dBA-sound power) in a part load condition.
- Zone-ability: A heating and cooling system designed to maintain all areas of a home at the same temperature, at the same time, doesn't give its owner much flexibility. The Daikin Altherma system provides the option of dividing the house into two or more independently-controlled comfort zones. This configuration can reduce energy consumption by allowing for different setpoint temperatures in unoccupied areas. It also allows the comfort level of rooms to be adjusted to suit individual tastes and activity levels.
- Overall Energy Efficiency: The small size of hydronic and chilled water tubing compared to forced-air ducting of equivalent heat carrying ability greatly reduces heat loss from the heat distribution system. It also cost more to insulate the ducting because of its greater surface area. The electrical energy required to circulate water through a properly designed hydronic system is usually a fraction of that used to move air in a similarly sized forced-air system. The cost of operating a typical 90 watt hydronic circulator for 4380 hours per heating season in an area where electricity costs 16 cents per kilowatt-hour is $63.07. Comparing this to a small furnace using a 400 watt blower motor would have an operating cost of $280.32 for that same period. Hydronic systems that heat the floors of rooms with high ceilings reduce energy consumption by reducing air temperature stratification.

Zone-ability
Daikin Altherma with individually controlled zones

What Daikin Altherma can do:

- Heating (59°F/15°C to 131°F/55°C LWT), cooling (41°F/5°C to 72°F/22°C LWT) and supply DHW (to 176°F/80°C) from a single system using low temperature heat emitters.
- Reduces energy use, thus reducing energy cost.
- Delivers between 3 and 5 kWh of usable heat for every kWh of electricity used.
- Localized CO_2 emissions = 0

What Daikin Altherma is not designed for:

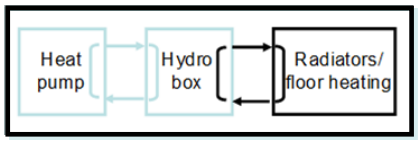
- Replace a boiler used for high temperature heat emitters (water loop temperature in excess of 131°F/55°C.
- Deliver high leaving water temperature (greater than 122°F/50°C) with heat pump only at outdoor ambient temperatures below 25°F/-4°C.
- Quick recovery of DHW (i.e. 50 gallons of water in 15 minutes). Typical recovery for heat pump only is 1 gallon/minute at an 80°F/44°C temperature rise.

How can Daikin Altherma be Applied?

Customizable to your location

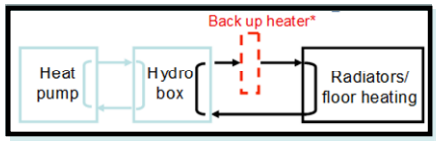
Daikin Altherma can be selected and optimized based on each projects individidual needs, ambient design condition and budget. It is possible to size your heat pump to cover the entire load, utilize an ambient balance point temperature and compliment your Daikin Altherma system with Back-Up Heat or utilize an existing/alternative heat source such as a boiler as an auxiliary system utilized for those extreme cold days. These are summarized as follows: -

Mono-Energetic



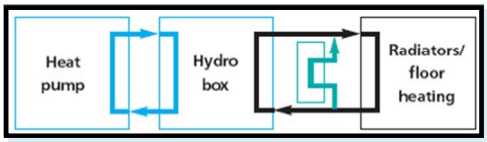
100% Heat pump coverage : selection of bigger capacity and higher investment cost heat pump

Mono-Valent



Best balance between investment cost and running cost, results in lowest Lifecycle Cost

Bi-Valent



Utilization of Heat Pump then switching over to alternative heat source like boiler for ultra cold climate heating days

The ultimate system in flexibility

New Construction • Concealed Units or Duct Free exposed • Cooling • Solar • Renovation / Replacement • MonoBloc or Split System • Space Heating • • Zoning or Single Zone • Partial house or Whole House • Domestic Hot Water

The ultimate system for home comfort

Daikin Altherma – A great solution for LEED®, Low Energy and Net Zero Energy Homes

The Daikin Altherma product portfolio offers many attributes that make it appealing to the "green" movement and growing scope for high efficiency homes.

Scope	Feature / Attribute
Environment	1. All equipment contains materials that can be **recycled**. 2. Altherma system inherent design and operational features mean effective tie in to **Grid-Tied Solar PV** (Low start up amps, operating amps, no locked rotor amps etc). 3. DHW Production via Optional/3rd Party **Solar Thermal** solution and using the "**Aero Thermal" Daikin Altherma** serving as the Auxiliary Solution. 4. A heating and DHW solution with **NO Localized CO_2 emissions.**
Efficiency	1. Enhanced energy savings via **Inverter Compressor** operation where energy consumption matches the load. 2. Further savings via the **Outdoor Reset Function** to control LWT depending on Ambient temperatures. 3. Operational **efficiencies (COP up to 4.5) similar to or better than Geothermal WSHP** solutions, without the added cost of well drilling, excavation etc
Application	1. Excellent **flexibility for the architect / designer** to apply the Altherma system to suit any home design, scale or performance scope. 2. Unobtrusive and **aesthetically pleasing** complete Heating, Cooling and DHW 3. Full utilization of hydronic circuit, thus small diameter piping, high heat transfer coefficient and comfort of **Low Sound Level** In-Floor Radiant, Low Velocity Fan Convectors or Radiators.

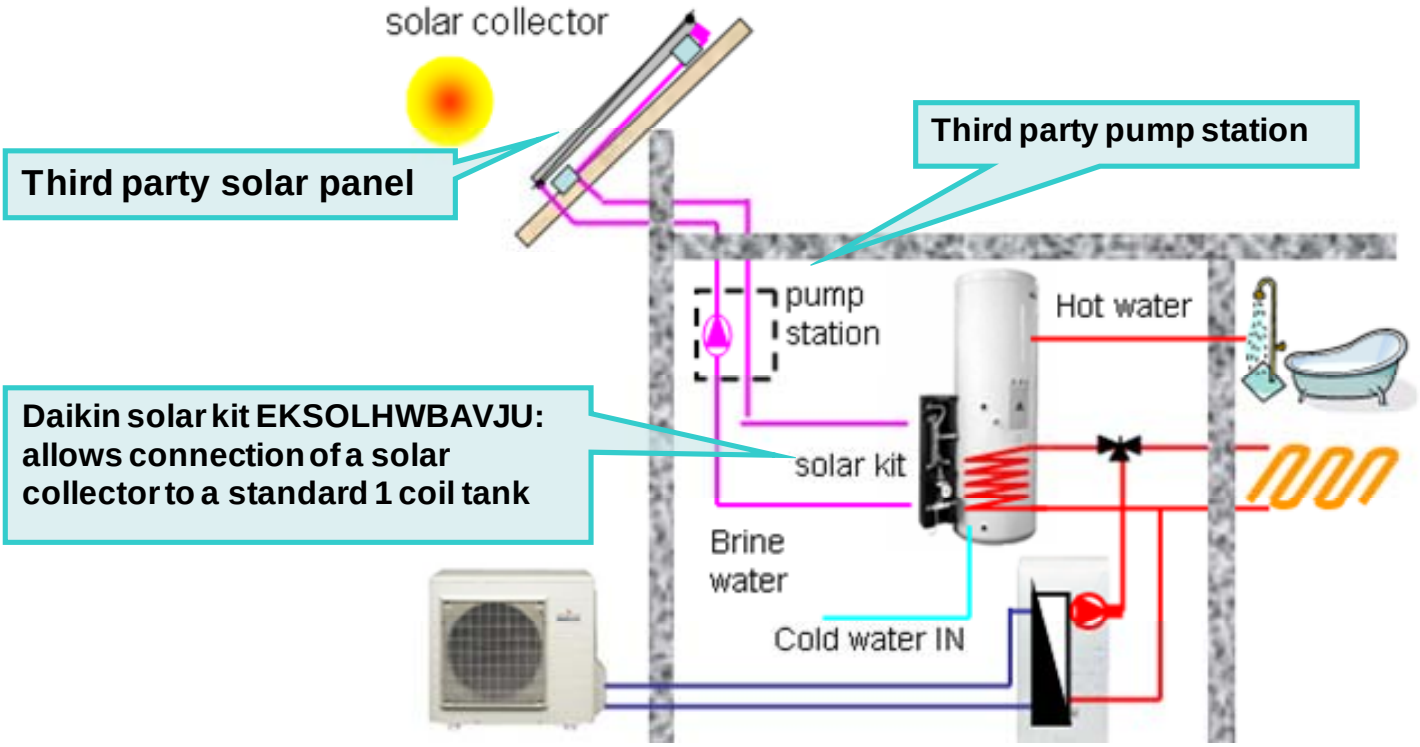
Daikin Altherma – Using Solar Thermal for DHW applications

The use of solar energy is categorized into two applications

- Electrical use:
  - Photovoltaic - because of the low starting amps of the inverter driven compressor, Altherma is ideal for photovoltaic solar applications
- Thermal use:
  - Solar thermal makes up more than 90% or the solar energy capacity installed worldwide*
    - Domestic hot water heating
    - Space heating

The Daikin Altherma Air to Water Heat Pump systems can be combined with solar thermal systems and provide auxiliary creation of DHW via aeothermal energy from the heat pump and back up and booster heat energy via electrical resistance elements

The optional solar kit (EKSOLHWBAVJU) can be connected to the Daikin domestic hot water tank. The solar kit enables domestic hot water to be heated by the sun when solar energy is available. The solar kit intergrates the field-supplied solar thermal panels with a field supplied pump station and the Daikin domestic hot water tank. Solar domestic hot water priority can be defined through the Altherma interface control.



* **ESTIF: Solar Thermal Action Plan for Europe**

Daikin Altherma System Design and Operation Recommendations

Three (3) steps for a good design:

1) Accurate calculations of heat losses (transmission and ventilation losses).
2) Selection of Daikin Altherma based on heat loss calculation and preferably for low water temperature application (95°F/35°C to 104°F/40°C). Use the available Daikin Altherma selection and software tools.
3) Selection of heat emitters should be based on design ΔT of 9°F/5°C for optimum efficiency and capacity. The actual heat emitter ΔT can be designed between 5°F/3°C to 14°F/8°C. The circulator in the hydrobox section has a three speed motor and is factory set on high speed; remember to match the circulator speed with the required system flow (lower circulator speed can be selected at lower flow and head). If the system flow exceeds 12 gpm @ approximately 10 feet of head, a primary/secondary hydronic piping system is recommended.

Design hint: If the heat losses exceed the single total Altherma capacity at design ambient conditions, multiple Altherma systems may be used in unison to aid greater DHW consumption or larger heating loads in single zones. For multiple zones it is highly recommended to utilize multiple (separate) systems. Daikin Altherma can also be applied using an auxiliary boiler connected in parallel (Bi-Valent application)

Recommended Altherma leaving water temperature (LWT) selections conditions:

86°F/30°C to 95°F/35°C (at design conditions) for floor heating
86°F/30°C to 113°F/45°C (at design conditions) for fan coil units
104°F/40°C to 122°F/50°C (at design conditions) for low temperature radiators

Operating the System:

To get the most comfort with the lowest energy consumption with Daikin Altherma, it is very important to observe the following items:

- Define possible schedule timer actions for each day by filling out the form at the end of the operation manual can help minimize energy consumption.
- Make sure the heat pump system works at the lowest possible hot water temperature to heat the home. To optimize this, make sure the weather dependent set point (outdoor reset) is used and configured to match the installation environment (use the available selection and software tool).

Next recommendations apply to installations with an optional domestic hot water (DHW) tank:

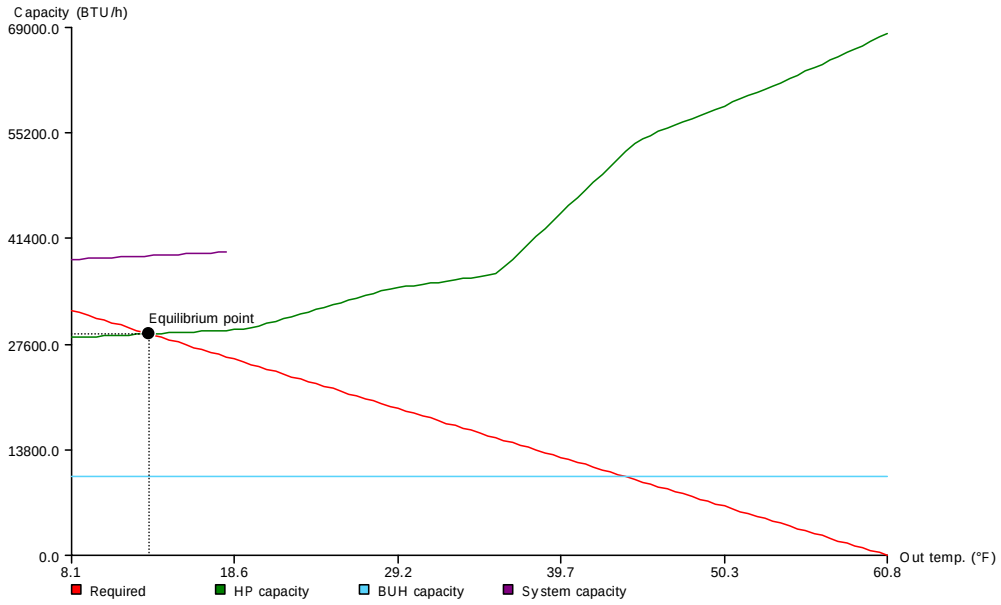
- Make sure the DHW is only heated up to the hot water temperature required.
- Optimize the scheduling of DHW operation of the Altherma system so that DHW is heated via the system 1-2hrs prior to the DHW being required (refer to the schedule timer function and programming explained in the users operation manual).

Performance and Efficiency Simulation

Heating

Simulation in Baltimore, Maryland with 1800 ft^2 house with 32,000 BTU/h loss at 104°F leaving water temperature using radiant under floor heat (Daikin Altherma Simulation Software).

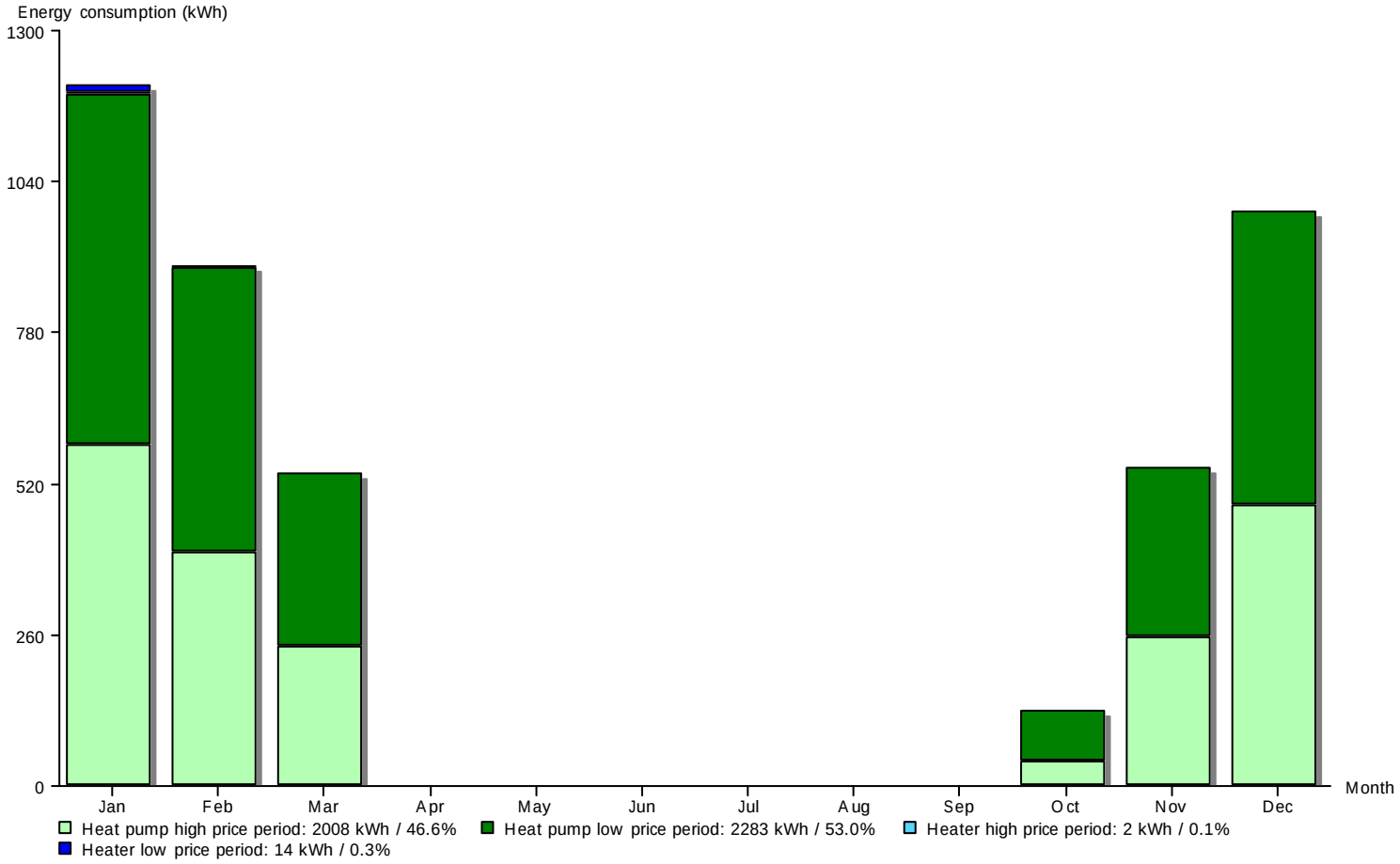
Required and available capacities



Equilibrium point	13.1°F / 28937 BTU/h	Seasonal COP	3.2
Total thermal energy	13681 kWh		

HP capacity (Heat pump capacity): The integrated heat generation capacity of the heat pump. This value takes into account the energy used for the defrost cycle. Heat pump capacity depends on the outside temperature and the leaving water temperature. The simulator calculates the heat pump capacity at the minimum night temperature in the winter as described in the meteorological data.
BUH capacity (Backup heater capacity): The nominal heat generation capacity of the electrical backup heater.
System capacity: Total heat generation capacity of the system, i.e. the sum of heat pump capacity and backup heater capacity.
Spare capacity: The surplus in heat generation capacity when compared to the required heating capacity, i.e. the difference between system capacity and required capacity.
Equilibrium point or equilibrium temperature: The outside ambient temperature at which the heat pump capacity matches the heating demand. It is therefore the lowest outside temperature at which no additional heat source is needed. The heat pump can cover the entire heating demand down to this outside temperature. For outside temperatures below this equilibrium temperature, additional heat from the backup heater is required to fulfill the heating demand. During transient conditions at system heat-up, the equilibrium point can shift to a higher temperature than the one it would be at during normal operations.

Energy consumption per month



Yearly energy consumption 4307 kWh
Primary energy use 10768 kWh

Design conditions
Required capacity
32000 BTU/h

Surface to be heated
1800 ft²

Zero capacity at outside temperature
60.8°F

The graph shows the energy consumption (input) per month for the heat pump and back up heater. There is made a separation between day and night operations to show the amount of energy consumption that falls under day and night tariff.

Independent Performance Verification

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Performance Assessment of an Advanced Hydronic Heat Pump

1017887

EPRI (Electrical Power Research Institute) tested a Daikin Altherma heat pump with domestic water heating at its Knoxville, Tennessee laboratory for operation and performance in a semi-controlled environment. The system tested has a nominal heating capacity of 38.2 kBtu/h (11.2kW). EPRI conducted a series of "draw test" for the water heating component of the Daikin Altherma system between August and October 2009. Using procedures loosely based on the U.S. Code of Federal Regulations water heating protocol[1].

The draw test were conducted using Daikin Altherma's heat pump only mode (i.e. no electric resistive heat elements were enabled) and a 120°F/40°C water tank temperature setting. Four (4) draw tests were executed, and a summary of each draw test is provided in Table 1.

As shown in Table 1, the water drawn out of the tank for each draw test is generally between 47 and 49 gallons. The average power draw during the reheat period was consistent among the four draw test (1.6kW to 1.8kW), however the maximum power draw varied quite largely (2.9kW to 4.4kW) with no apparent correlation to average outdoor temperature. The overall COP (Coefficient of Performance is quotient when "energy out" is divided by "energy in") increases with increasing average outdoor temperature, as should be expected with an outdoor heat pump unit. A graph showing the trend of overall COP verses average outdoor temperature is shown in Figure 1.

[1]"Uniform Test method for Measuring the Energy Consumption of Water Heaters." Title 10 Code of Federal Regulations, Pt. 430, Subpt. B, App. E. 2009 ed., 176-194. Print.

Independent Testing of Daikin Altherma Domestic Hot Water Operation

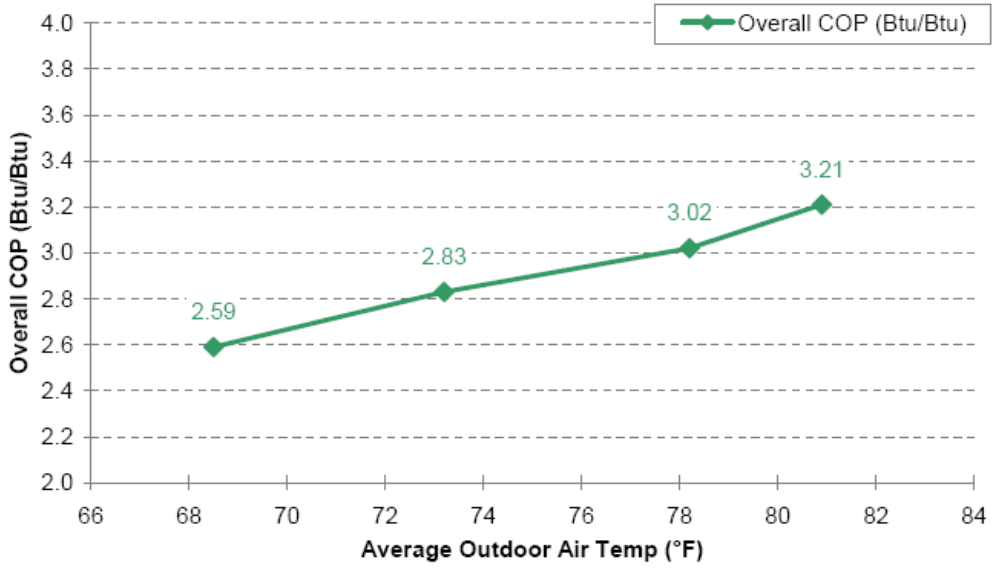
Table 1

Summary of Draw Test Results for Altherma Water Heater

Test Number	1	2	3	4
Test Duration (hours)	1.9	1.7	1.5	1.5
Indoor Temp, Avg (°F)	71.9	71.2	73.9	73.0
Indoor Humidity, Avg (%RH)	45.7	45.6	44.2	47.4
Outdoor Temp During Reheat, Avg (°F)	68.5	73.2	78.2	80.9
Outdoor Humidity During Reheat, Avg (%RH)	88.1	76.1	60.7	56.9
Water Draw Flow Rate, Avg (gpm)	2.7	3.0	3.0	3.0
Water Draw Inlet Temp, Weighted Avg (°F)	54.6	58.2	58.8	59.0
Water Draw Outlet Temp, Weighted Avg (°F)	119.3	119.4	119.6	120.1
Water Draw Volume (gal)	48.9	49.3	47.9	46.7
Water Draw Energy (ton-h)	2.2	2.1	2.0	2.0
Electric Power Reheat, Avg (kW)	1.7	1.7	1.8	1.6
Electric Power Reheat, Max (kW)	4.4	2.9	4.3	3.0
Electric Energy Reheat (kWh)	3.0	2.6	2.4	2.2
Overall COP (Btu/Btu)	2.6	2.8	3.0	3.2

DHW Draw (Tapping) test results ranged from 2.6 – 3.2 COP

Figure 1

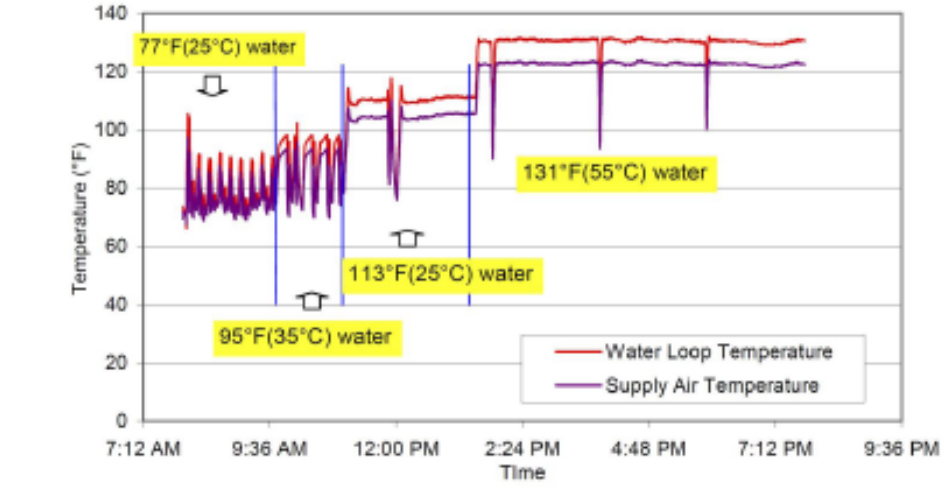


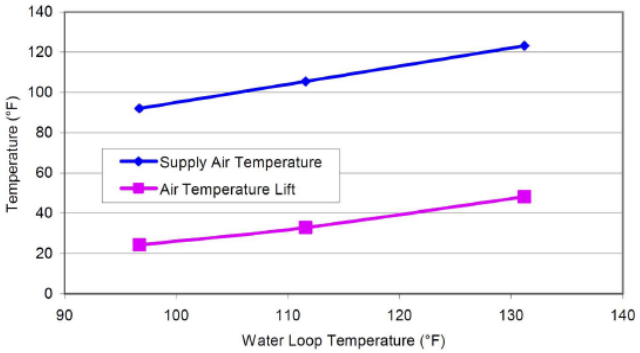
Independent Testing of Daikin Altherma Heating Operation

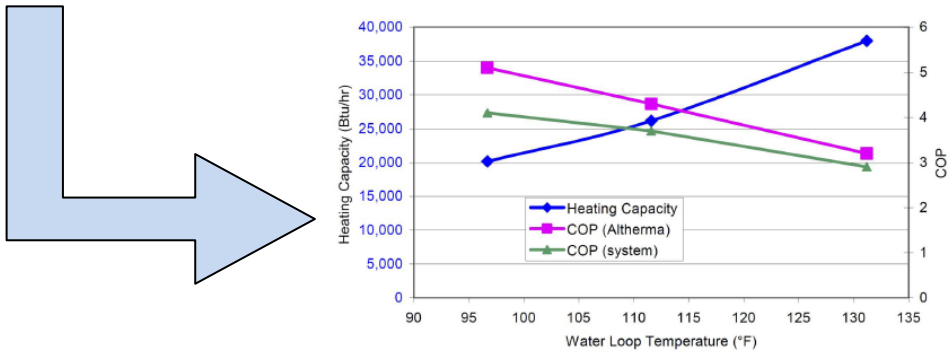
In the heating mode, hot water is generated by the Altherma hydrobox and is circulated through the heating water loop and heat is supplied to conditioned space through a fan coil air handler. The water loop temperature can be set through the Daikin Altherma controller in the range from 77°F (25°C) to 131°F (55°C).

Steady-state tests were run with water loop temperatures of 77, 95, 113, and 131°F (25, 35, 45, and 55°C). Figure 2 is a heating profile showing actual water loop temperature at the entrance to the fan coil and supply air temperature. The water loop temperature setting was adjusted throughout the test and the setting is indicated above or below the appropriate part of the graph and highlighted in yellow.

Figure 2







Daikin Altherma Case Study

The Challenge

Oregon locals embarking upon building the most sustainable energy efficient home possible, wanted a heating solution worthy of their green vision.

Daikin's Solution

The first U.S. installation of Daikin Altherma™ - a domestic heating and hot water solution providing outstanding performance even during the coldest months.

Application:
Residential

Location:
Portland,
Oregon
USA

The Bauman-Broussard home, which received a LEED Platinum rating, is the site of the first installation of Daikin Altherma in North America.

Daikin Altherma indoor Hydrobox with optional domestic hot water tank.

Standard low temperature radiators deliver comfortable heating in the Bauman-Broussard home.

Case Study – Recorded Energy Consumption & Operating Cost

MONTH	kWh Used	kWh Sold	NET kWh Used	Energy Use Charge Calc	Actual Cost	Avg kWh/Day	Avg Cost/Day	
Feb-09			635	250.000 kWh x 5.12400¢ 385.000 kWh x 6.89900¢	$12.81 $26.56	43.1	$2.32	partial month: begin 2/13
March	1058	56	1002	250.000 kWh x 5.12400¢ 752.000 kWh x 6.89900¢	$12.81 $51.88	33.4	$2.16	
April	674	98	576	250.000 kWh x 5.12400¢ 326.000 kWh x 6.89900¢	$12.81 $22.49	20.5	$1.26	
May	533	196	337	250.000 kWh x 5.12400¢ 87.000 kWh x 6.89900¢	$12.81 $6.00	10.2	$0.57	
June	373	115	258	250.000 kWh x 5.12400¢ 8.000 kWh x 6.89900¢	$12.81 $0.55	8.8	$0.46	
July	395	171	224	224.000 kWh x 5.12400¢	$11.48	7.4	$0.38	
August	413	129	284	250.000 kWh x 5.12400¢ 34.000 kWh x 6.89900¢	$12.81 $2.35	8.8	$0.47	
Sept	433	117	316	250.000 kWh x 5.12400¢ 66.000 kWh x 6.89900¢	$12.81 $4.55	10.5	$0.65	
Oct	634	45	589	250.000 kWh x 5.12400¢ 339.000 kWh x 6.89900¢	$12.81 $23.39	20.3	$1.22	lower apt filled
Nov	1175	14	1161	250.000 kWh x 5.12400¢ 911.000 kWh x 6.89900¢	$12.81 $62.85	35.1	$2.29	
Dec	1694	11	1683	250.000 kWh x 5.12400¢ 1433.000 kWh x 6.89900¢	$12.81 $98.86	52.5	$3.49	
Jan-10	1040	3	1037	250.000 kWh x 5.12400¢ 787.000 kWh x 6.89900¢	$12.81 $54.30	38.4	$2.49	
Feb	1037	42	995	250.000 kWh x 5.12400¢ 745.000 kWh x 6.89900¢	$12.81 $51.40	31	$2.01	
March	963	67	896	250.000 kWh x 5.12400¢ 646.000 kWh x 6.89900¢	$12.81 $44.57	30.8	$1.98	
Total YTD:	**10422**	**1064**	**9993**	**AVG YTD:**	$0.00	**25.05714286**	**$1.5536**	

Summary

The residential heating, cooling and domestic hot water markets and requirements are changing;

- Energy Prices - the ever rising prices of fossil fuels due to increasing demand and reduced availability (also affects the price of electricity that is generated by fossel fuel)
- Ecological Concern - efforts to reduce emission of green house gases and energy consumption
- Changing Legislations, Incentives - to support the drive towards major changes in energy consumption habits for the purpose of achieving ecological targets in an effort to slow down, stop or even reverse climate change.

Market changes have driven home owners to seek alternatives to mainstream heating and cooling (i.e. central air conditioning systems with combustioned based ducted furnaces for heating, or combustioned based boiler systems) for their homes. Daikin Altherma can be applied with fossil fuel backup and thermal solar (hybrid system) for heating and DHW, forced air with chilled water for cooling, and has less install limitations than geothermal (no drilling or excavation); the versatility of Daikin Altherma makes it a viable alternative by combining an inverter driven compressor heat pump into a hydronic system that heats and cools the space along with the option of supplying domestic hot water with thermal solar option.

Conclusions

Daikin Altherma offers many advantages over traditional heating and DHW solutions. It provides significant viability to deliver efficient and eco-responsible comfort based on the following attributes that have been explained throughout this document: -

- **Eco-efficient design**
- **Utilization of renewable energy from the outside air**
- **high full load and excellent part load efficiencies**
- **Attractive, “affordable” system price**
- **High operating and service reliability**
- **Low installation costs**
- **Flexible and simple installation**
- **Adaptable to radiant floor, fan coil & radiator applications**
- **No local consumption of fossil fuels**
- **30-98% reduction in total CO_2 emissions**
- **Optional year-round comfort with active cooling function**
- **Simple match up for solar thermal and/or grid tied solar PV**
- **Excellent solution for Low Energy / Net Zero Homes**