

# TECHNOLOGY OVERVIEW STATEMENT

CATEGORY		
<input checked="" type="checkbox"/> Residential Energy Efficiency	<input checked="" type="checkbox"/> Commercial or Industrial Energy Efficiency	<input checked="" type="checkbox"/> Renewable Energy
<input type="checkbox"/> Other (Please explain)		

INFORMATION ABOUT NOMINATOR			
Nominated by: Lee Smith	Affiliation	Daikin AC (Americas), Inc.	
Address 1645 Wallace Drive, Suite 110			
City Carrollton	State TX	ZIP	75006
Country The United States of America			
Phone 972-512-1909	E-mail Lee.smith@daikinac.com		

TECHNOLOGY DESCRIPTION
Describe the technology (attach additional pages if necessary)
<p>Daikin Altherma is an Electrically Driven Air to Water Heat Pump system designed to provide space heating (via under floor, low temperature radiators or fan coil units), domestic or sanitary hot water and space cooling. It combines heat pump hot water system for domestic use with space heating and cooling. The air-source to water heat pump system is designed to replace conventional fossil fuel boilers (Gas/LPG/Oil/direct electric). Unlike the typical heat pump system on the current market which is limited in application by the low-ambient temperature, Altherma efficiently extracts low-level heat from the ambient air and raises it to temperatures capable of comfortably heating a house and providing domestic hot water in outdoor temperatures down to -20° C. In doing so, Altherma makes use of renewable aero-thermal energy.</p> <p>The Variable Speed technology based heat pump technology employed is highly efficient (3 to 5 kWh of heat for every 1 kWh of electricity consumed). The product was recently award European Eco-label (2009) being recognized as a renewable energy solution.</p> <p>The Daikin Altherma system has the following characteristics and applications:</p> <ul style="list-style-type: none"> <li>• Daikin Altherma can be installed as a two-unit split system consisting of an outdoor compressor unit and an indoor unit or "Hydrobox" containing the hydronic parts. Alternatively, the system can be installed as a monobloc system with a single outdoor unit combining the compressor and hydronic parts.</li> <li>• The split system includes R-410A refrigerant piping between the outdoor unit and the Hydrobox, and water piping between the indoor unit and the indoor heating appliances/tank. The monobloc system includes water piping between the outdoor unit and the heat emitters / DHW tank.</li> <li>• The Daikin Altherma system heat pump compressor incorporates inverter technology, with an integrated frequency-converter that adjusts the rotational speed of the compressor to meet the heating or cooling demand. Therefore, the system seldom operates at full capacity.</li> <li>• The domestic hot water tank includes a supplemental electrical heating element to boost the Domestic Hot Water temperature if necessary.</li> <li>• The Altherma system also can be tied into a solar thermal collector system that supports the production of domestic hot water.</li> <li>• The Hydrobox for the split system and contained in the outdoor unit in the monobloc system both include a built-in electric back-up heater to provide additional heating during extremely cold weather.</li> </ul>
What is the technology's current and expected future cost?
<p>The Daikin Altherma system has costs consistent with that of High Efficiency Variable Speed Heat Pump systems, but has the added benefit of integrated Domestic Hot Water Solution. With this kind of technology, while the first costs (equipment only) are typically higher than existing technologies, the total system cost (including installation) is very competitive. The customer who purchases the systems can then be comfortable in the fact that the total cost of ownership can be significantly lower than traditional systems, with payback often achieved in 3-5 yrs.</p> <p>As an indication, based on initial sales, a complete Daikin Altherma system can be purchased and installed for \$10,000 - \$12,000.</p> <p>In future, as economies of scale are achieved and certain key components can be localised, it is anticipated that up to 25% cost reduction can be achieved on the mass production side, which will then lower the market price for this type of technology.</p>
What alternatives to this technology are currently in the marketplace?

Currently there are no direct alternative suppliers in the U.S. of Air to Water Heat Pump systems that can combine Space Heating, Domestic Hot Water and Space Cooling. The technology is very prevalent in the rest of the world though and it's our understanding that other manufacturers will launch such technology in the U.S. in the coming years.

There are similar systems available in the U.S. that adopt a "heat pump" type configuration to supply a hydronic space heating or cooling solution or systems, again using a heat pump configuration, but only supplying Hydronic Space Heating and Domestic Hot Water. Nothing specifically matches the Daikin Altherma product that is integrated to provide all three solutions.

For further information about what is available in the U.S., the following websites offer some insight to some of the alternatives: -

<http://www.aquaproducts.us/reverse-cycle-chiller/about-the-rcs.html>

<http://unicosystem.com/Home/Products/UniChillerRC/tabid/80/Default.aspx>

What are the current or potential market barriers to this technology?

The technologies as well as the product are widely available in Europe. However, it will be new to the U.S. market and general public. The manufacturer (Daikin) name recognition, the lack of end user awareness of the technology benefits, and potentially initial cost of the product could become the market barriers in the beginning stage.

How can this technology fit into existing energy efficiency and renewable energy programs?

The Daikin Altherma technology delivers excellent efficiency due to the Heat Pump characteristics (using renewable energy from the outside air) and the part load benefits of the INVERTER Compressor Technology, using only the electrical energy needed to satisfy the requirements of the home. However, the current testing and rating programs do not have an appropriate technology category for technology that is of Air to Water design and can solve Hydronic Heating, Domestic Hot Water and Cooling requirements in a single packaged solution.

## ENVIRONMENTAL BENEFITS AND IMPACTS

Explain in detail how this technology reduces greenhouse gas emissions. Describe calculation methodology and include references.

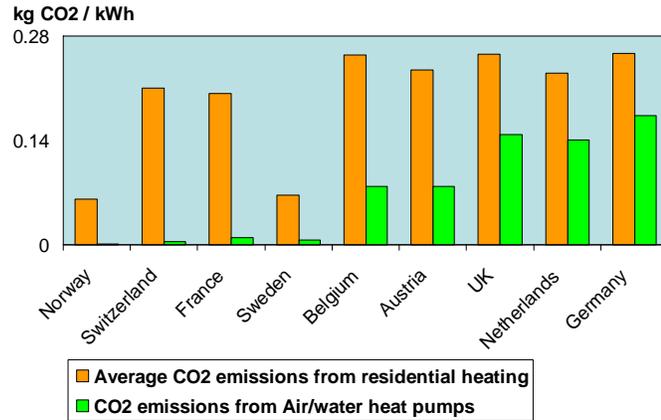
High COP and seasonal operation, extremely low CO2 emission versus traditional fossil fuel heating systems.

As no tangible data exists yet for the U.S. market, provided below is the situation and comparison of the benefits from Europe where Daikin Altherma has been successfully commercialized since 2006.

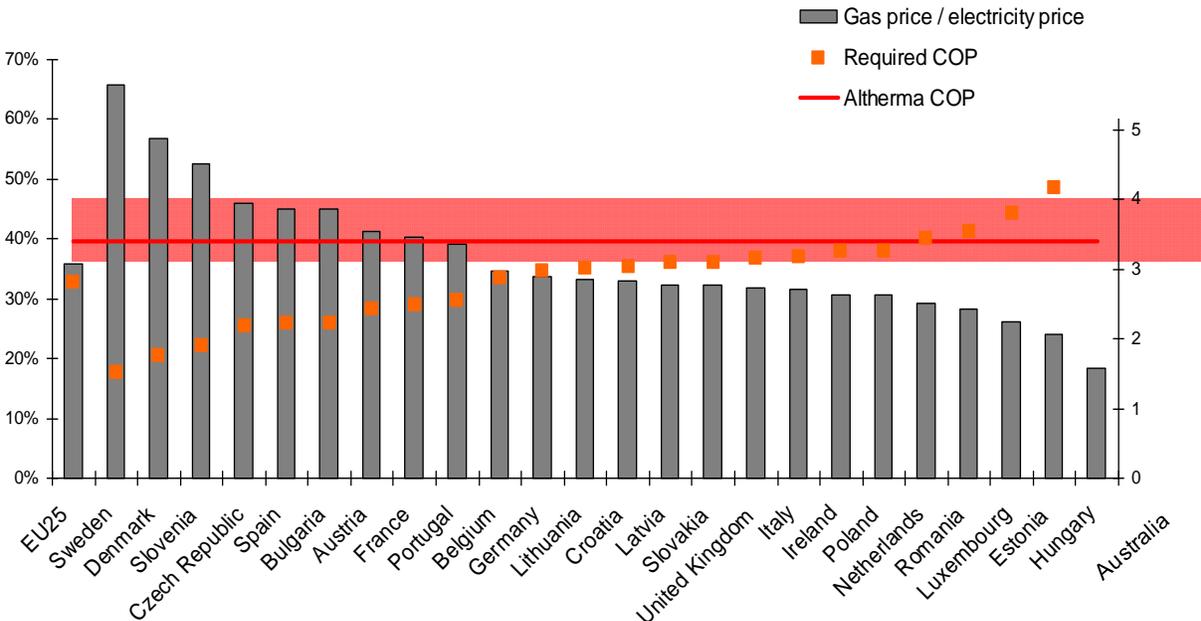
Table of Average CO2 emissions by Heating System Type

kg CO2/ kWh (% share)	Average CO2 emissions	Gas boiler	Fuel boiler	Electric heater	Air/water HP	Water/water HP
Austria	0,235	0,217 (50%)	0,296 (30%)	0,233 (15%)	0,078	0,051 (5%)
Belgium	0,255	0,217 (50%)	0,296 (40%)	0,276 (10%)	0,078	0,06
France	0,203	0,217 (50%)	0,296 (30%)	0,032 (5%)	0,009	0,007
Germany	0,257	0,217 (57%)	0,296 (35%)	0,517 (5%)	0,173	0,112
Netherlands	0,231	0,217 (70%)	0,296 (25%)	0,421	0,141	0,092 (5%)
Norway	0,061	0,217	0,296 (20%)	0,003 (70%)	0,001	0,001 (10%)
Sweden	0,067	0,217	0,296 (20%)	0,014 (40%)	0,006	0,003 (20%)
Switzerland	0,211	0,217 (35%)	0,296 (45%)	0,011 (10%)	0,004	0,002 (10%)
UK	0,256	0,217 (60%)	0,296 (35%)	0,442 (5%)	0,148	0,096

Graph showing the CO2 emissions reduction from using Daikin Altherma



Graph summary of Gas/Electricity price trend in EU versus the required COP and the Daikin Altherma COP



Are there additional environmental impacts or benefits associated with this technology (e.g. water use, toxicity, etc.)?

Other than the Environmental benefits highlighted (CO2 emissions reduction, excellent COP and part load performance, use of HFC refrigerant R-410A) an additional consideration is that over 90% of the components in the Daikin Altherma systems can be effectively recovered and recycled based on standard recycling schemes that exist today.

## COMPANY DESCRIPTION

Describe the company or companies who offer this technology, including company size, years in operation, major business focus, partners and investors.

### **About Daikin AC (Americas), Inc.**

Daikin AC offers North America intelligent air-conditioning solutions and heating with superior energy performance and sophisticated design. The company, based in Carrollton, Texas, is a subsidiary of Daikin Holdings (USA), Inc., which is owned by the Japanese-based Daikin Industries, Ltd. Daikin's products offer superior energy performance and sophisticated design. These advanced systems fall under the Daikin Altherma™, Quaternity™, VRV®, VRV®-WII, VRV®-S, and SkyAir product names. For more information, call 866-4DAIKIN or visit [www.daikinac.com](http://www.daikinac.com).

### **About Daikin Europe N.V. (Manufacturers of Daikin Altherma)**

Daikin Europe N.V. is the sales and manufacturing head quarter responsible for the air conditioner sales in Europe, some parts of Africa and the Middle East.

Daikin Europe N.V. was formed in 1973 in Ostend, Belgium. The intervening years have seen this facility progressively transformed into over 150,000m<sup>2</sup> and the most advanced air conditioning plant in Europe, producing equipment for markets as diverse as Norway and South Africa.

The recent addition of European production facilities in Plsen and Brno in the Czech Republic have added to capacity and optimised lead times to all markets. The company has wholly owned affiliates in the UK, Spain, Germany, Italy, France, Belgium, Greece, Portugal, Poland, Central Europe, South Africa, The Netherlands and Sweden a network of independent distributors throughout Europe, Africa and the Middle East and offices in Dublin, Moscow, Istanbul & Dubai.

### **About Daikin Industries, Ltd. (Daikin AC and Daikin Europe Parent Company)**

Daikin Industries is a global provider of residential, commercial and industrial-use heating, ventilating, air-conditioning and refrigeration (HVAC&R) products and services and holds leading market positions in Japan, Europe, China and South East Asia. Daikin is also a well diversified company with well established business developments in fluoro chemicals and oil hydraulics. Daikin boasts an unparalleled combination of mechanical, electronic, and chemical expertise as well as robust R & D capabilities. The company continues to leverage these strengths to create new, innovative products through flexible, highly efficient production systems. The Daikin Group products are sold in more than 100 countries internationally with a combined US \$12.5 billion sales in FY2008. Daikin has over 39,000 employees worldwide and has over 200 subsidiaries and affiliates. Daikin Industries, Ltd is a publicly held company traded in Japan, and traded on the Tokyo Stock Exchange ([www.daikin.com](http://www.daikin.com)).

Attach Key Leadership profiles.

Not Applicable

## TESTING PROCEDURES

Summarize third party validation and testing that has been performed on this technology. Attach studies.

The Daikin Altherma product as an Air to Water Heat Pump is certified to a wide variety of standards in Europe. The programs include: -

Eurovent ([www.eurovent-certification.com](http://www.eurovent-certification.com))  
Promotelec/Vivrelec  
NF PAC ([www.certita.org](http://www.certita.org))  
Credit d'impot  
ECA (<http://www.eca.gov.uk/etl/find/>)  
D-A-CH  
SEI  
EU flower – Ecolabel ([www.eco-label.com](http://www.eco-label.com))

These programs reference and are in accordance with the following testing and rating standards: -

Eurovent Std 6/C003/2006  
European Std EN14511 (Parts 1 – 4)

A summary of the performance requirements of each program is included as an attachment to this application.

The Daikin Altherma system was the first of its kind in Europe to be recognized by the EU for its high environmental performance. Please see the attached press release announcing this award or view the following weblink: <http://www.daikinaltherma.eu/eco-label.jsp>

Describe standards or testing procedures that exist or are under development that could be used to establish criteria for product recognition. Attach additional pages if necessary.

To our knowledge, there is no alternative test procedure that is applicable within the United States to test accurately and to rate the performance of air to water heat pump systems that provide both heating and that can also serve domestic hot water and cooling functions such as Daikin Altherma. However, DACA's sister division, Daikin Europe N.V. (DENV) is currently marketing Daikin Altherma systems in Europe. To address the local EU requirements regarding testing and rating of the Daikin Altherma system, DENV has approached the matter in two ways as follows: -

Full Load Performance and Efficiency: -

Daikin Altherma is tested and rated to EN14511

Annual Performance and Efficiency: -

Daikin Altherma is rated to EN15316

Standard EN14511, *Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling*, is an internationally recognized standard that is used throughout Europe.

Standard EN14511 is published in 4 sections and clearly defines Terms and Conditions (-1), Test Conditions (-2), Test Methods (-3) and Requirements (-4). The overall scope of the standard is stated in EN14511-1:2004(E), Section 1, Scope, which states that the standard:

*specifies the terms and definitions for the rating and performance of air and water cooled air conditioners, liquid chilling packages, air-to-air, water-to-air, air-to-water and water-to-water heat pumps with electrically driven compressors when used for space heating and/or cooling. This European Standard does not specifically apply to heat pumps for sanitary hot water, although certain definitions can be applied to these.*

Standard EN14511, which is attached, provides the full criteria to establish full load performance ratings for Air to Water Heat Pump Systems.

Standard EN15316, *Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies*, is an internationally recognized standard that is also used throughout Europe.

The portion of the standard that is relevant to Daikin Altherma is Standard EN15316-4-2, which is attached. A brief conceptual summary of Standard EN15316-4-2 follows:

The Scope of Standard EN15316-1 (Section 1) states that this standard "specifies the structure for calculation of energy use for space heating systems and domestic hot water systems in buildings." *The standard's calculation method enables the energy analysis of the various sub-systems of the heating system, including control (emission, distribution, storage, generation), through determination of the system energy losses and the system performance factors. This performance analysis permits the comparison between sub-systems and makes it possible to monitor the impact of each sub-system on the energy performance of the building." Id.*

**SIGNATURE OF NOMINATOR**

I certify that my answers are true and complete to the best of my knowledge.

Signature



Lee Smith  
Director – Product, Engineering & Applications

Date; January 5<sup>th</sup>, 2010