



Black to stay Cold

This article introduces a heating and cooling technique based on a black wall as one of the 100 innovations that shape "The Blue Economy". This article is part of a broad effort to stimulate entrepreneurship, competitiveness and employment. For more information please consult www.zeri.org or www.blueeconomy.de.

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The Market

The world market for heating, ventilation and air conditioning (HVAC) will exceed \$70 billion in 2012. Global demand for equipment will rise annually with 5.8 percent. The Asia/Pacific region will outpace the rest of the world led by China and India, reflecting rising standards of living. Cooling equipment will outpace heating systems. As customers become used to the comfort of air conditioning in their car, they will increasingly expect it in their homes. The market is stable with the seven largest suppliers accounting for more than four - fifths of all sales.

Energy savings and environmental protection are the two main themes for the sector. The industry used to rely on CFC refrigerant gases that destroy the ozone layer. The industry collaborated to substitute these with more benign chemicals. As of late, CO₂ emerged as the most likely substitute in both automotive air conditioning as well as in heat pump water heaters (HPWH). The standard CO₂ HPWH was developed only a few years ago mainly thanks to a collaborative effort of nine Japanese companies, including Daikin, Hitachi, Toshiba, and Panasonic.

Whereas CO₂ is also a greenhouse gas, the industry considers the amount released by HVAC negligible in comparison to the amount of CO₂ released from power plants and vehicles. However, the major drawback is that CO₂ systems must be under five times higher pressure than traditional equipment. This creates a series of new engineering challenges. In order to achieve high efficiency, low noise, low vibration and high internal pressure requires the use of heavier pipes of more expensive alloys, driving up demand for specialized metals.

The Innovation

The next wave of innovations seems to be the integration of the internet with HVAC controls. The traditional thermostat combined with internet communication standards and web controls extends the concept of smart buildings to include analysis, decision and control tools to facilities and homes with real time data, that was typically reserved for industrial applications. Intelligent control systems monitor and optimize energy consump-



tion, send out notifications and reports geared towards lowering total cost over the entire lifecycle of the system.

The most fundamental shift in thinking in the world of HVAC is the capacity to eliminate the traditional compressors, and air pumps thanks to the design of a heating and cooling system based on the black wall. The building structure facing South exposes a black wall with an airspace in between the wall and a transparent polycarbonate, made out of horizontal airducts which include highly conductive aluminum foil. The outside air enters on the left and flows to the right until it reaches the vertical shaft, rises and releases its warm air into the hall way.

This air heating black wall exploits the laws of physics, operates without one moving part, and can by design secure a comfortable heating system without the need for any compressors, air pumps or mechanical devices. If the building is designed by an expert architect who had the tools to calculate the appropriate dimension of the wall and the shafts determining the required flows of air, based on historical data of outside temperature, moisture levels and the desired inside temperate. The same system can be used in the summer time along the same principles. However the garage now rather needs cooling instead of heating. Thus the hot air, now generated more rapidly passes through a heath exchanger and is converted to cold air using the same principles as the refrigeration technique where warm air is removed to create cold air.

The simplicity of the design requires minimal maintenance (washing the windows occasionally). Since it has no moving parts, there is no metal wear or friction, thus the system requires less maintenance and consumes no energy. Actually, this heating and cooling system has the potential to generate electricity in the process. The capital investment is minimal, the energy savings are obvious, the maintenance hardly required, and the benefits are obvious.

The First Cash Flow



The black wall pictured here has been in operation since 1995 and was commissioned by Per Carstedt, the Ford dealer in the region of Umeå, who has a track record of pursuing cutting edge energy efficient building designs. It is part of the GreenZone, designed by Anders Nyquist who has designed a large number of prime energy and water efficient buildings in Europe, Asia, Africa and Latin America. The well documented performance of



the small industrial cluster at the GreenZone, combining a gas station (Statoil), a fastfood restaurant (McDonalds) and a Ford dealership has been so positively received by both the investors and the occupants, that a second advanced GreenZone with the latest technologies is scheduled for 2011.

The Opportunity

While many take the time and effort to travel three hours North of Stockholm to observe this marvel of design in operation, it took a company like Toyota to realize the impact of this simple approach to harnessing the heat, instead of blocking it out as is usually done with a South facing wall. After full analysis the Japanese car maker decided to commission its future Scandinavian offices and dealership to Anders Nyquist. The fact that the architect could deliver proof of performance at lower cost, while also demonstrate that he can operate in different cultural and climatological environments including Japan, where he renovated the buildings of Daiwa House in Sendai, Northern Japan, convinced Toyota that he was the lead building designer.

It is expected that the Black Wall to Warm and Cool will be increasingly popularized thanks to the visibility created by Ford and Toyota. The design is actually simple, and with a minimum insight in physics in general and air flows in particular permits a standardized approach to this HVAC system that will free up capital while bringing more comfort at lower prices to all occupants. Whereas this design cannot be applied to the airconditioning in cars, trucks and trains, it does permit an overhaul applying the concepts of "substituting something with nothing" as is proposed by the Blue Economy.

Photo: Anders Nyquist

For further background on the 100 cases:
www.blueeconomy.de

Pre order the book „The Blue Economy: 100 innovations – 10 years – 100 million jobs“ at
<http://www.paradigm-pubs.com/catalog/detail/BluEco>.