



Case 10

Fresh Air for Free

saves energy, reduces capital cost and secure healthy living

This article introduces building designs in general and air conditioning in particular 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.blue economy.de

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The Market

The world market for air conditioning is valued at \$62 billion, residential represents 39 billion for over 45 million units installed annually. The control of temperature is one of the key costs in building management and a major contributor to climate change. The the biggest growth in the business comes from the developing countries, topped by China. Heat exchangers and condensers, used to recover some of the lost energy are valued at \$2.5 billion. Air filters, needed to clean out particles, pollen and germs are growing to \$2 billion.

Real estate developers have increasingly invested in building management systems (BMS), a computer steered control system that monitors light, water and air flows through the facilities. The cost of the hardware of a ten story building for air controls could easily cost \$3.5 to 5 million, while the cost of operation and maintenance can run as high as 25 percent of annual running expenses. Buildings are responsible for 45 percent of the UK's overall greenhouse gas emissions. In the US, buildings represent 70 percent of all energy use and 38 percent of all CO2 emissions.

The European Commission released a report outlining that as many as 90 percent of all existing buildings have inappropriate controls of energy consumption for heating and cooling of water and air, and require a complete overhaul of the existing systems installed. This could lead to a reduction of energy consumption in existing facilities by as much as 30 percent.



The Innovation

Bengt Warne, the late Swedish architect and his team studied back in the 1950s the natural air and humidity controls of termite nests in Tanzania and Zimbabwe. These nests use the laws of physics to regulate air flows, temperature and humidity without any external power source. Warne concluded that these colonies have the capacity to farm mushrooms underground thanks to a meticulous building design that maintains temperate at 81°F and 61 percent humidity. Through a detailed observation it became clear that the height of the mounds, the length and width of the air channels as well as the position towards the sun and the choice of building materials all contribute to the management of air.

There is a broad history of naturally ventilated buildings around the world, like the hospital built at Las Gaviotas in Colombia or the *Shosoin* storehouse at the Todaiji Temple in Nara, Japan, both providing comfort in a very hot and humid climate. It was another Swedish architect Anders Nyquist who motivated a team to design a mathematical model that built on this exposure to termite mounds, but could offer predictable results to the building designers. He applied the modeling technique for the construction of the Laggberg School in Timrå by Sundsvall and demonstrated that this approach brings tangible benefits beyond energy savings, not only for hot and humid but also for dry and cold climate.

The air is refreshed every hour without imposing any additional heating or cooling cost, while the additional benefit is that dust particles and germs are continuously channeled out of the building promoting the health of the occupants. Then Nyquist and his team added the interplay between black and white to the outside design, imitating the shifts of darkness and light as the zebra does. Another simple application of the laws of physics, where hot air is thinner and rises, while cold air is denser and settles at the bottom. The Ford dealership in Umeå, Sweden and the office buildings of Daiwa House in Japan provided concrete case studies that demonstrate the effectiveness of this approach

The First Cash Flow

While many look for energy savings, using existing equipment more efficiently, Nyquist and Warne identified building designs that simply eliminate the existing energy and capital intensive standard on the market with building designs that incorporate the intelligence of ecosystems. These architects introduce the law of physics as applied by zebras and termites into a remarkable new type of building design. The application of these observations in nature create multiple benefits starting from savings in capital and reducing operational expenses, to improving the inner air quality. Children at school are exposed to the simple applications of the theory of physics while dramatically reducing the carbon footprint of a building. While the buildings are well insulated, the air flows through the premises without the need for additional heating or cooling.



The Opportunity

While this approach does not stimulate the business of the HVAC suppliers it does offer an interesting new business model to the real estate development companies. If there is no HVAC system in the building, then there is no need for airducts in the ceiling. This eliminates an estimated 40 to 50 centimeters of space in between two floors. This means that for each five floors, there is an additional floor within the same volume of building space. Thus saving money is now complemented with an increase in revenue, and a reduction of risk. When a typical 10-floor building will break-even when 55 percent of the apartments and offices are sold, the construction that saves capital and reduces operational expenses will typically break even at 46 percent.

The design of these energy saving buildings reduces the investment risk. A lower risk due to a lower break-even point, secures cheaper financing, further reducing costs and further reducing the risk even more. The Eastgate Shopping Center in Harare, Zimbabwe is a surprising first major example of such an innovative application of building design. Even when outsiders would shy away from any major real estate development in a high risk nation like Zimbabwe, this one has proven to beat all expectations. This office and shopping complex has a proven track record. It became the most popular building in Harare, first and foremost since its operational expenses are the lowest and the attraction to the public at large is the highest. Who would have expected that perhaps the most ecological office and shopping complex stands tall in Zimbabwe?

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

To pre-order the book *The Blue Economy: 100 innovations - 10 years - 100 million jobs*, please go to <http://www.paradigm-pubs.com/catalog/detail/BluEco>.