

Green Visionary Scholarship

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Every winter in New York City, where I live, boilers, heaters, and de-icers launch into full blast as soon as the temperature drops below 55 degrees. The city's temperatures in spring and autumn vary widely from day to day, and large buildings rarely adjust to a comfortable temperature in time for the next swing. This phenomenon causes both discomfort for residents and energy waste. So there are two related problems: (1) large buildings cannot maintain a constant temperature amid changing weather, and (2) current technology can only heat or cool on full blast. Similar issues plague cities across the country, and I believe the next innovations in green construction will tackle these problems with (1) Internet of Things technology and (2) smarter insulation.

First, how will Internet of Things (IoT) technology aid in green heating, ventilation, and air conditioning (HVAC) innovations? IoT refers to the practice of integrating everyday objects into the world wide web in order to send and receive data. Many people already know about smart thermostat companies like *Nest*, and these products already have a healthy adoption rate in residential and commercial applications. But I recently spoke to the CEO of an innovative HVAC startup who told me that similar technology has not yet been adopted for several industrial applications. His company specialized in skyscraper de-icers. Skyscrapers, especially tapered and glass buildings, run the risk of building up huge ice sheets that can fall with lethal velocity to the street below. Thus, many buildings in New York come equipped with exterior heating apparatuses to ensure that ice cannot build up in cold weather. But currently, almost every skyscraper in New York has one sensor on the roof that turns the de-icing heaters on full blast as soon as the temperature drops below 40 degrees Fahrenheit.

One need not be an HVAC specialist to see that this current system is extremely wasteful. Obviously, a building does not need the same heat for 40 degrees as it needs for 20 degrees below zero. Ironically, many of these modern buildings have advanced technology for internal HVAC, but on the outside they are using the same blunt sensors as everyone else. Similar inefficiencies plague the necessary heating systems for pipes

and plumbing. These industrial applications need a less wasteful solution, and entrepreneurs like the one I met are working to add smart technology to modulate the heat that these systems put out. When most people think of HVAC, they think only of the inside temperatures of their living areas or office spaces. But the next green revolution in construction will arrive once people recognize that external and industrial HVAC systems deserve developers' attention. Certainly the profit motive can help drive building managers to adopt smart systems, but I would also advocate implementing a special LEED certification credit for smart plumbing and de-icing heaters.

Multi-family residences could use heat modulation as well. New York City law currently mandates that apartment buildings be at least 68 degrees Fahrenheit from May to October if the outside temperature is 55 degrees or less. Coming from experience, this means practically that landlords set the heat too high in the early fall and late spring. IoT technology could help landlords better modulate their temperature to approach a comfortable equilibrium in the changing seasons.

Nonetheless, domestic HVAC still has a long way to go on its own, when it comes to green innovations. *Nest* and other smart thermostats have helped to create efficient HVAC systems for living quarters and residences. But no matter how quick or efficient one's thermostat is, if one has poor insulation, air leaks, or inefficient ducts, then one will continue to lose money and to have rooms with uncomfortable temperatures. This is a problem for both residential and commercial buildings. A study from the United Kingdom showed that around 72% of domestic emissions came from heating.¹ Yet this issue is different from the de-icing problem. With de-icing, the waste came at the source of the heat, since the systems lack sensors to modulate based on the temperature. In the domestic case, people are usually at home, and they will adjust the thermostat to their comfort. Instead, the waste comes at the destination of the heat, when energy escapes homes.

Thus, this problem in particular can be deceptive. The greenest, most energy efficient HVAC system on earth might still be expending loads of unnecessary energy if

¹ https://www.designingbuildings.co.uk/wiki/Sustainability_in_building_design_and_construction

heat readily escapes from the building. Ironically, we can see this phenomenon especially in some LEED certified buildings. In New York, perhaps the most prominent example is 1 Bryant Park, also known as the Bank of America Tower. The structure famously captured the world's first LEED platinum rating for a skyscraper due to its construction from recycled materials and innovative water and air recycling systems. But the astute observer notices quickly that 1 Bryant Park has a completely glass outer shell, as so many new large buildings in New York are. Even the best glass and glazes are much poorer insulators than basic wood and fiberglass walls.² The tower certainly has many impressive features for energy conservation, but sometimes conventional construction techniques can save tenants the most money and energy. Instead of glass, developers and architects should spend their time crafting buildings with walls that can be paired with thick insulation. Obviously this will take a different shape for skyscrapers than it does for residential homes, so the next generation of green engineers should take on the challenge of sustainably insulating steel and concrete buildings.

Though we are seeing only the stirrings now, I believe that green insulation will ignite an energy revolution and reduce HVAC costs across the globe. Some initiatives, such as the Zero Energy Project, have shown how innovative construction techniques with insulation can help homes get as close to zero net energy as possible. For example, they advocate heavily insulating floors to achieve 360-degree insulation and avoid heat loss through crawlspaces.³ Efficient recycling practices and high-tech thermostats can only do so much, and we will see intense gains in sustainability once people widely accept that the most significant green developments can occur during construction.

² <http://www.originalgreen.org/blog/2010/1-bryant-park-and-the-leed.html>

³ <https://zeroenergyproject.org/build/twelve-steps-affordable-zero-energy-home-construction-design/super-insulate-net-zero-building-envelope/>