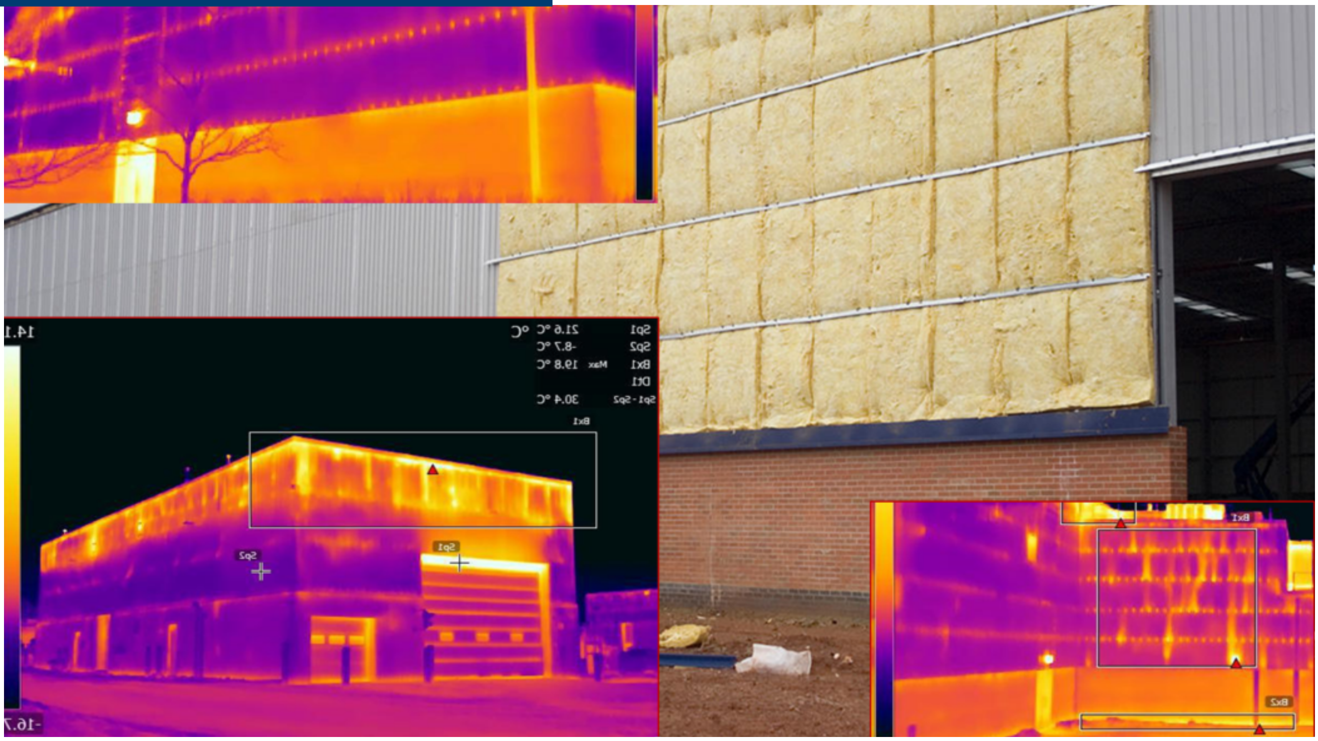

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Building Envelope Retrofit Projects:

Making Data-Driven Decisions to Reduce Energy Losses

By Mansour Asrani and Susan Horne

Any project, including a building retrofit, benefits from having several key components: a measurable goal, an action plan, and a way to evaluate the results. Although these would appear to be simple enough, often retrofit projects lack the specificity and clarity needed for their success.

Mansour Asrani

Susan Horne

Because the building envelope is the "face" of the building to its occupants and the public, and because so much energy loss is attributed to the building envelope, it should be an obvious target for retrofit projects. Still, building envelope retrofit projects may be especially prone to lack of clarity and foundation in known facts.

Assumptions & Resources

Retrofits to remedy energy losses through the building envelope are sometimes based on assumptions (if we repair the roof, the moisture problem will be solved), uncertainty (this retrofit needs to be done, but we don't know the short and long term payoffs), failure to prioritize spending according to the most urgent requirements (let's fix the sealing because that's the cheapest, not necessarily the most critical thing to do), and failure to consider the values and mission of the building owner (a decision to improve the aesthetics when there are more pressing issues to be considered for the long-term sustainability of the building).

Both financial and human resources may be wasted when plans are based on assumptions, decisions are made without proper research, and returns are uncertain. This waste will be addressed by data-driven decision-making. In fact, reliable data should be the underpinning of any business decision.

A Data-Driven Approach

Data-driven decision making involves measurable project goals that are based on unbiased, objective data. Research should be conducted, and the required data collected before the plans are set – not after, as is sometimes the case. Quality data obtained should allow for various alternatives to be considered and evaluated to determine the best course of action that serves the organization's purpose. The facts need to be assembled into an at-a-glance overview with graphics or visualizations from which actionable insights may be gleaned. Such a report should be user friendly and understandable by all stakeholders, not just a select few. Data powers the engine that is constant improvement.

Data is a useful tool, but only if the resources exist to gather it and analyze the data about energy losses related to the building envelope. Assemble it into an orderly, comprehensive, meaningful collection and weed out the irrelevant details. Extract the most significant facts based on the goals, values and mission of the organization. Establish specific retrofit goals as a result. Define and prioritize the problems and determine the most effective use of limited funds to address the issues. Quantifiable costs should be weighed against measurable benefits. Priorities need to be established, and a complete plan developed. A data-driven approach should be a pillar of the organization's culture.

A data-driven approach to retrofits offers additional long-term benefits: objective data collected is useful for clearly documenting the concrete results of efforts made to achieve energy reduction targets, achieve GHG reduction targets, and become more sustainable. Energy performance can be compared before and after the retrofit in quantifiable terms. The data can be used to demonstrate retrofit outcomes when communicating with stakeholders, building occupants, financial institutions, and government.

Thermal Imaging

Historically, attempts to determine where energy losses in the building envelope occur have not generated precise data, nor have they provided the means to benchmark the "before" and "after" status of a retrofit. These same methods have been inconvenient for building occupants; hi-rise buildings make such information gathering even more difficult, if not impossible.

The introduction of infrared cameras mounted on drones has enabled buildings to "see" the energy losses due to faults in the building envelope, including in hi-rise buildings. Infrared is used to measure the heat radiated by aspects of the building envelope. An up-close visual inspection of a particular wall may show no visible signs of cracks, for example, but a thermal image may tell a much different story.

Thermal images clearly reveal differences in temperature between the outside air and the surface temperature of the various components of the building envelope based on real conditions at the present time. They are based on factual data instead of the reported perceptions of cold spots or drafts by building occupants.

Many temperature differences are unintended and unwanted. Some may indicate the presence of moisture inside the wall. When moisture-laden air is allowed to penetrate the building's exterior through cracks and crevices, it condenses and may wet the insulation. Other temperature differences are caused by convective air currents (air leaking out of the building due to cracks or cavities in the building envelope) and conduction (heat moving from a warmer object to a cooler one).

Drone Technology

The use of drones to identify energy losses has changed the landscape of building inspections for this purpose. The next challenges are: What can be done with this data? Of all the sources of energy losses, which should be addressed first? Which energy management strategies will generate the best return on investment? These are the questions faced by building owners, investors, and property managers alike.

Reliable Evaluation

Only by knowing the precise cost of the energy wasted can a realistic plan be created to remedy these failures, starting with the most critical ones. The existence of artificial intelligence (AI) to calculate and quantify these energy losses defines the next evolution of building envelope retrofit opportunities. AI enables the data acquired by the drones to be actionable on a broad scale.

The cost of energy losses due to leaked gas in a single insulated gas unit (IGU) can be over $60.00 per year. This amount is staggering when you consider a hi-rise building with over 4000 of those poor performing IGUs – a total, an annual loss of over $275,000! Based on reliable data, such dollar values make a building envelope retrofit project a worthwhile investment.

Only by reliably identifying energy losses, analyzing the data, quantifying it, assessing costs versus benefits, and establishing priorities can a data-driven retrofit plan for rectifying building envelope failures be created. ■

Mansour Asrani is a project manager at QEA Tech with 20 years of experience working on innovation and technology development with a decade of successful experience in cleantech and environmental solutions. Mansour specializes in image processing and precise imaging technologies. He is responsible for managing building envelop thermal inspection and energy loss quantification projects.

Susan Horne is a retired College Chair and is currently self-employed as a writer/editor of reports, articles, curriculum, and textbooks.
www.qeatech.com