

MIT analysis helped us to see why it was important to start there.”

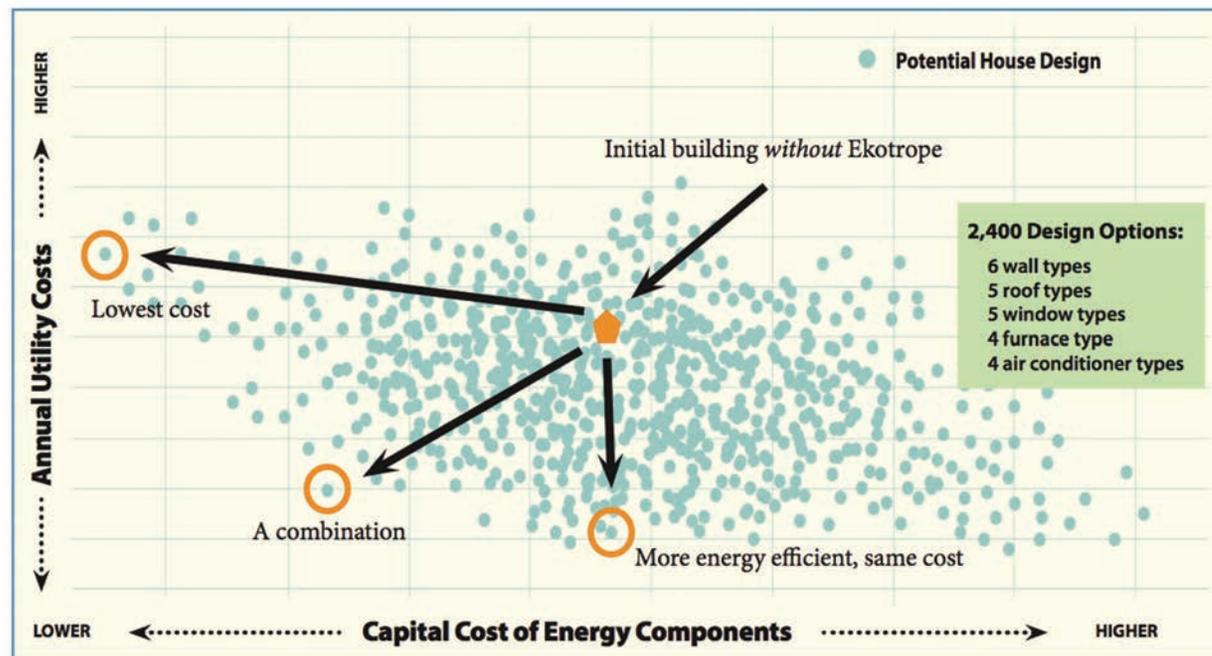
Using these tools for figuring out the most sensible plan of attack for a complex project would work well not only for space missions, as Crawley found out, but also for home construction. He was looking to build an energy-efficient and cost-effective home for himself, and he realized there was no sufficient way for his architect to analyze how different combinations of components impacted the trade-off between cost and energy efficiency. Inspired by his NASA experience, in 2010 Crawley and his team at MIT developed a Pareto frontier-based software program called Ekotrope, which he used to not only construct his home but also start a business.

Benefits

For anyone who has ever been involved in designing and building a home with both cost effectiveness and energy efficiency in mind, the virtually endless number of construction methods can be overwhelming. “Manually trying to figure out optimal combinations of windows, walls, insulation levels and materials, HVAC systems and so on is too complicated and time-consuming,” says Ekotrope CEO Ziv Rozenblum.

But just like the Mars-oriented software tool, Ekotrope analyzes the numerous design options to arrive at the most promising architectures. All a builder needs to do is input into the cloud-based program known parameters for the future house, such as its interior and exterior dimensions, the potential materials (there is an extensive drag-and-drop menu that’s always being updated), and its orientation.

The software takes that information and runs it against a year’s worth of local weather data for the area. It quickly produces a graph with the vertical axis representing annual energy costs and the horizontal axis the total cost for building components and equipment. The graph contains thousands of dots representing all possible design options. But as with the Mars analysis, the builder need only pay attention to the Pareto frontier: the set of dots that populate the edges where either energy or construction costs, or both, are low. A builder can then



By utilizing his work with NASA, Crawley developed Ekotrope, a software tool that helps homebuilders narrow down the thousands of design options to the ones that are the most cost- and energy-efficient.

choose from those options based on specific cost, energy efficiency, and design considerations.

The resulting plan saves the builder a considerable amount of money. According to Rozenblum, a typical client will end up choosing a house that’s up to 40 percent more energy efficient and will save \$1,000–\$3,000 in construction costs. “For a company that constructs thousands of homes a year, that’s millions of dollars saved on building costs alone,” he adds. “The results are pretty staggering.”

Sometimes the results are even more dramatic, he says. For example, one customer believed her best investment would be to buy expensive walls that could retain heat during the winter. After using Ekotrope, the team convinced her to invest in a more efficient furnace instead. “A more energy-efficient furnace will get you the same result as the wall system while saving you 90 percent,” Rozenblum recalls telling her. “We ended up saving her \$20,000. It’s unbelievable.”

In the few years since its founding, the Cambridge, Massachusetts-based company has seen steady business

growth, with residential construction firms drawn to Ekotrope’s ease of use and ability to help builders meet energy codes cost-effectively. Another benefit is that builders are also equipped with the ability to display to prospective owners the financial benefits of energy-efficient improvements. As an example, a builder in Florida is using Ekotrope to improve design and demonstrate a less than one-year payback on a super-efficient house which, under normal usage, has zero utility costs.

The technology’s genesis couldn’t have come from a more audacious undertaking: sending humans to Mars.

“Everyone knows NASA is at the forefront of innovation and technology, but we don’t always get to see the benefits in other sectors on a day-to-day basis,” says Crawley, who is company chairman. “That is why spreading this innovation into new industries is so important and exciting; we can use it to immediately improve our world in so many different ways.” ❖