It’s easy to talk in the classroom about the need to integrate economics into energy systems designs. It’s another thing entirely to put that knowledge to the test consulting for a Fortune 100 firm grappling with energy-intensive operations, a volatile economy, stockholders with an eye on the bottom line, and looming policy changes liable to transform the economics of energy.

This past year, the Verizon Foundation gave students the opportunity to put their education to the test with a $160,000 grant to fund a quartet of master’s-level projects.

Brandon LaBrozzi, M.Eng. ’10 ChE, analyzed using renewable energy to cool cell phone tower equipment buildings as part of the new Energy Systems and Engineering specialization in chemical engineering. In early April, LaBrozzi was one of a dozen undergraduate, master’s, and Ph.D. students to present their preliminary findings to a roomful of top-tier Verizon Wireless executives, including CEO Lowell McAdam ’76 ME, a former member of the Cornell Engineering Advisory Council. For the executives, the projects were more than an academic exercise: the telecommunications giant is looking for sustainable alternatives to increase energy efficiency and lower operating costs.

“It’s not every day you give a presentation to a CEO unless you’re in the business,” says LaBrozzi, a 26-year-old native of Bradford, Penn., who worked as a high school chemistry teacher after earning his bachelor’s degree in chemistry, math, and physics at Penn State, Bradford. “It was a personal challenge to make sure we had our ducks in a row, make sure we were giving the executives good information, get them excited, sell them on the idea.”

The presentations—which also included smart-grid, fleet management, and inventory logistics teams—are such a success that a week later, a second team of executives came to campus to hear more from the students. “It’s much better for students to do real-world work, interact with the people who have to deploy their findings, instead of just doing an academic exercise,” says Croll Professor of Sustainable Energy Systems Jefferson Tester ’66 ChE, M.S. ’67, LaBrozzi’s mentor. “It’s like medical training in the emergency room — where the resident has to solve problems as they come through the door, not just talk about them.”

When McAdam expressed interest in collaborating with the college in early 2009, Abby Westervelt, director of Cornell Engineering’s Corporate and Foundation Relations, arranged for him to come to campus, give a public lecture, and meet Professor Tester. Later, she drafted a proposal to the Verizon Foundation, facilitated non-disclosure agreements, and coordinated meetings to refine parameters and review progress.

“This is a great example of a partnership that originated with a company looking to solve interesting problems,” says Westervelt. “The relationship developed very flexibly and quickly, starting with the engagement of a high-level alumnus who saw the opportunity to harness the broad interest on campus in energy systems like geothermal, smart grid, and transportation to the real-world challenges of an operating company like Verizon.”
School’s Sage Hall and Duffield Hall, Cornell’s nanoscience facility, technology based on a case study of team that developed smart grid undergraduate on the six-member Bojanczyk ’10 BE was the only goals of faculty. needs of students and the research projects, meeting both the educational an appropriate test bed for student sustainability initiatives could provide times with interested professors consumption at times of increased supply. they were advised automatically adjust heating and cooling systems to reduce the country, could be integrated into a smart grid developed by one of the student teams.

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One of the student projects found that ground surface temperatures, depicted on this map, are a determining factor in the feasibility of geothermal cooling for cell phone tower equipment buildings.

One student project drafted a management plan for Verizon’s vehicle fleet, which added 145 alternative energy vehicles, like this natural-gas powered van, in 2010.

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— JEFFERSON TESTER, CROLL PROFESSOR OF SUSTAINABLE ENERGY SYSTEMS

but in the weeks following graduation he was still focused on his work with Zhang, laying out plans for future studies. For his project, Lallozzi needed a crash course in geothermal heat pumps—which embed a closed-loop heat exchanger in bore holes as an alternative to conventional air conditioning units—followed by visits to cell phone towers in the Ithaca area and a lot of modeling and spreadsheet time. He and Ed Dodge, a member of Cornell’s research staff, also consulted regularly with professional geothermal heat pump installers and the trio of Verizon Wireless engineers who defined his project’s parameters.

“They wanted to get an idea of whether it was a possibility to design a system for the worst-case scenario and install it all over the country,” says Lallozzi, who integrated data on soil geology, summer and winter temperatures, and geothermal system designs to assess cost variability across the lower 48 states. “In the worst case, the total number of bore hole feet required was 3,500 and in the best case it was 200. That adds up to a $20,000 difference in install price.”

As a result, Lallozzi urged the engineers to take a site-specific and developed guidelines to help them identify conditions in which the savings from geothermal installations would most likely recoup the company’s initial investment. Perhaps even more important, he analyzed the effect of installing air economizers—essentially, large fans—to take advantage of cool temperatures (in winter, for example, and at night) and reduce cooling loads, in combination with either geothermal or with the existing air conditioning systems. Based on today’s electricity prices, Lallozzi estimated it would take more than two decades for the hybrid geothermal system to outperform hybrid air conditioning on cost, even when he accounted for savings of likely carbon emissions costs in the future. Only when he factored in the possibility of reduced equipment prices based on volume purchasing did geothermal become cost competitive. Ultimately, Lallozzi says, Verizon’s decision will depend on how the company purchasing did geothermal become cost competitive. Ultimately, Lallozzi says, Verizon’s decision will depend on how the company weighs such goals as reduced reliance on fossil fuels.

Throughout his project, Lallozzi got to work hand in hand with one of the country’s leading geothermal experts, “Jeff and I met once a week, as often as we could,” he says. “He just has so much experience—especially in geothermal, but also energy in general. To be exposed to that and benefit from all of his contacts in the industry was just great.”

“It was a good lesson in engineering analysis for us,” says Tester, who notes that with 30,000 towers in service, Verizon Wireless has an incentive to implement savings as soon as possible. “Energy management is the critical issue for them, particularly with uncertain future electricity prices. If you were designing cooling systems for their towers from scratch, you might do it differently.” Assistant Professor of Civil and Environmental Engineering Oliver Gao supervised two groups, each a trio of graduate students, developing new algorithms to help Verizon enhance its fleet and inventory management systems. “This is not only exciting academic research, but also has the benefit of seeing the findings applied to the real world and having real value,” says the professor. “Nothing can be more effective in terms of exciting students than having them see that they can make contributions.”

Unlike other groups he’s mentored, where data collection challenges can yield significant frustration, he saw both groups gain momentum as the Verizon Wireless engineers with whom they worked supplied concrete numbers. “Having access to real-world, complicated data made them more passionate,” says Gao. “It gives students a chance to think new ideas, figure out how to deal with real-world data, incorporate it, and produce sensible results.” As his M.Eng. students delved into the gritty details of their projects, Gao found that his mentorship relationship with them was substantively different from any that had emerged with students in his lecture-based courses. “You have to work closely with students having technical difficulties,” he says. “The adviser has to be a member of the team.”

Working to solve some of corporate America’s energy problems gave all six students a better appreciation for regular coursework, as well, says Gao, allowing them to recognize the value of what they’ve already learned and identify gaps in their expertise that might affect their future career success. He also saw tremendous growth in their ability to communicate their findings. “When they do homework, they get the answer and they’re done,” he says. “In this case, they had to interpret their final answers in terms of what it meant for Verizon. I was so proud of them.”

“Cornell’s infrastructure is pretty far ahead of the nation’s, and this is one area where they can make a significant impact,” says tester. But in the weeks following graduation he was still focused on his work with Zhang, laying out plans for future studies. For his project, Lallozzi needed a crash course in geothermal heat pumps—which embed a closed-loop heat exchanger in bore holes as an alternative to conventional air conditioning units—followed by visits to cell phone towers in the Ithaca area and a lot of modeling and spreadsheet time. He and Ed Dodge, a member of Cornell’s research staff, also consulted regularly with professional geothermal heat pump installers and the trio of Verizon Wireless engineers who defined his project’s parameters.

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