

The Pecan Street Project

Building tomorrow's electrical grid in Austin, TX



Julia Robinson

Turning on the power



The brand new Mueller neighborhood marks the first step in transforming the electrical grid of an entire city.

Dennis Mick is a car guy. The burly Austin, TX, retiree is sitting in the Cherrywood Coffeehouse, in east Austin, with a half-dozen neighbors. They're all from the nearby Mueller development, a new green community rising on the site of Austin's old airport, a couple of miles from the center of town. The topic under discussion, as Willie Nelson plays over the sound system, is energy.

Mick loves his Porsche and Mercedes. But his third car, a hybrid, is his favorite. "It tells me my gas mileage every second," he says, "and that's changed the way I drive all my cars."

Why, Mick asks, can't his house be as smart as his car? "My car tells me exactly how much energy I'm using," he says, "but in my house I have no idea how much I'm using or how efficiently. When I can see how much the electricity costs when I fire up the big-screen TV or the air conditioning—that's going to change my habits."

That prospect, of a day when people take charge of their energy use at home and at work, is at the heart of a shift that will transform America's energy infrastructure over the next 20 years. The Mueller neighborhood is ground zero of this change—the site of the \$30 million Pecan Street Project, in which Environmental Defense Fund is playing a leading role, to create tomorrow's electric grid.

Pecan Street aims to reduce Mueller's carbon emissions by 64%, compared to an average Austin neighborhood. For houses equipped with solar panels, the goal is that they consume no more energy than they produce and to produce zero net carbon emissions. More broadly, Mueller and the city of Austin will become a living laboratory to test ideas and technologies that will move the nation's \$1.3 trillion electricity market toward a future in which energy is cheap, abundant and clean.

"If you manage your energy footprint, you manage your environmental footprint," says Colin Meehan, an energy specialist in EDF's Austin office. "Smart grid development could produce

energy savings and reductions in CO₂ emissions of 30% by 2030.”

In the words of Brewster McCracken, Pecan Street’s executive director: “We are going to revolutionize how energy is produced, transported and consumed in America.”

Dreams of Revolution

The Mueller experiment began early in 2008 as an intuition.

Inspired by a conversation with a local entrepreneur, McCracken, then a city council member, began

thinking about producing solar power in cities, not in giant arrays way off in the desert. The idea was to create an electrical grid to support lots of clean energy and to make Austin the research and development hub of this initiative, creating lots of jobs.

By the spring of 2008, McCracken and six others, including leaders from the local utility, the Chamber of Commerce and research institutes affiliated with the University of Texas, were exploring the idea. “We got together to brainstorm,” recalls Michael Webber, a professor of mechanical engineering at the University of Texas. “Gee whiz, shouldn’t there be something better? So we started to come up with ideas for how the grid should be reinvented.”

Gradually, the group realized that it wasn’t enough just to produce local clean energy—you also had to distribute and manage it through an interactive system, like the Internet. And the old electrical grid wouldn’t work. They also realized that they needed help in turning their ideas into reality.

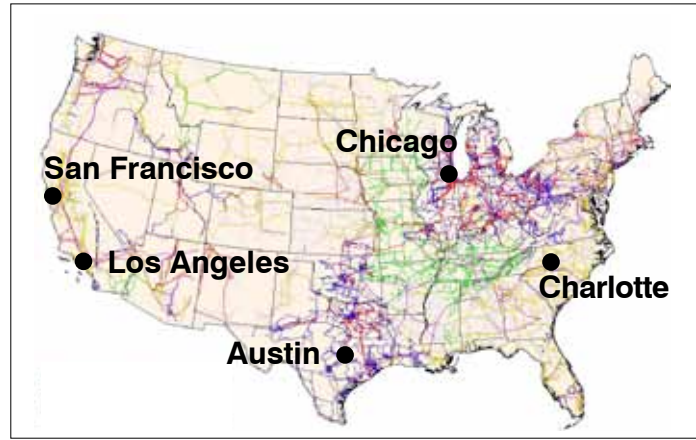
“We were still just throwing around ideas in bull sessions,” Webber says. “There were five different organizations in the room and we needed to bring in an honest broker, someone everybody trusted, who cared about the environment and was capable of getting things done.

In Austin, that’s Jim Marston and EDF.”

In the summer of 2008, McCracken approached Marston, EDF’s Texas regional director, about joining the project. “EDF agreed to help provide a vision, recruit folks from the corporate world and provide some analysis on potential environmental benefits,” Marston says.

One of the first things EDF did was to bring 11 major corporations onto an advisory board, including

Spreading the smart grid gospel



Transition grid map source: FMEA

EDF, the only environmental group directly engaged in creating smart grids in the United States, is working on grid projects in these cities.



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Roger Duncan (left) and Brewster McCracken, two of the Pecan Street Project founders, in the Mueller neighborhood.

GE, Cisco, Oracle and IBM. “We didn’t recruit money,” Marston says. “Instead, we asked the corporations for at least two people for nine months. We set up 11 working groups, whose recommendations we consolidated into a report.”

That report became the basis on which the group incorporated Pecan Street as a nonprofit in 2009. And with EDF’s help, the organization won a five-year, \$10.4 million stimulus grant from the Department of Energy for the Mueller project, which was supplemented by some \$20 million in local assistance.

“Suddenly, it’s a \$30 million project,” says Prof. Webber. “Now it’s real, and we all felt that having EDF on board early on was an important accelerator for us.”



Miriam Horn, EDF’s director of smart grid projects.

Electricity’s One-Way Street

The revolution McCracken and his colleagues envisioned has been long in coming. Since 1882, when Thomas Edison switched on the world’s first commercial generator in downtown New York City, the electric grid has been a one-way path from power plants to consumers.

We push a button and the lights come on, the elevator ascends, the coffee maker perks.

But as demand has grown—it rose 20% from 1999 to 2009—cracks have appeared in this system. Every day, on average, 500,000 Americans are without power for two hours or more. Large-scale blackouts are also on the rise—costing an estimated \$100 billion a year.

“The last two major blackouts in the Northeast were in large part due to underinvestment in the grid,” says EDF’s Marston. “We could have dramatically reduced the impacts of both if we had had modern infrastructure in place.”

The grid’s susceptibility to so-called cascading failure, in which large-scale outages grow from minor glitches, are a particular concern. For example, a major cause of the Northeast Blackout of 2003, which affected 45 million people in eight states, was that high voltage wires in Ohio brushed against some untrimmed tree branches. A smart grid would have allowed operators to isolate the problem before it spread.

New investment is coming: an estimated \$1.5 trillion will be spent upgrading the grid over the next 25 years. But how should it be spent—building ever larger versions of Edison’s machine? Since electricity cannot easily be stored in large amounts, that will require many additional power plants. Most will sit idle 95% of the year, cranking up just for those 100 hours or so when everyone runs their air conditioners full blast. But idling plants waste money and



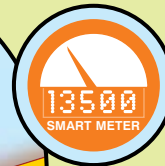
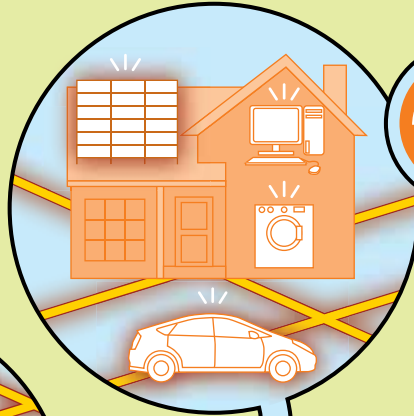
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Smart grid basics

1 Electricity from power plants and renewable sources travels over high voltage wires to users.

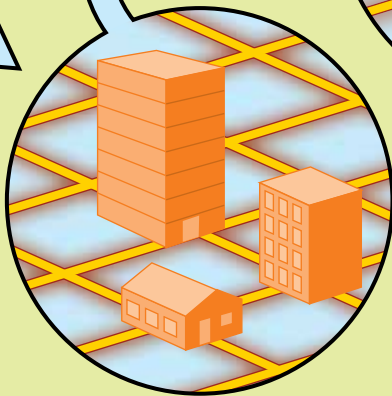


3 Homes (and businesses) produce as well as consume electricity through solar and other renewable technologies. Power sources, appliances and car batteries communicate to improve efficiency, cut costs and reduce environmental impacts.



4 Smart meters measure, in real time, power bought from and sold to the grid, letting consumers control energy use.

2 Transformers reduce voltage; electricity flows to communities through wire networks, which also feed power back into the grid from locally produced energy.



5 Renewable energy generation powers the home or is sold to the grid when prices peak. Energy stored in the battery of a plug-in car can power the home, or help stabilize the grid.

Icons by Carol Zuber-Mallison

energy, and emit vast amounts of air pollution.

“The country is going to spend money to upgrade the grid,” says Marston. “The question is whether we just replace the old system or create a new one with innovative, clean technologies.”

Hello, This is Your House Calling

In this new kind of grid, “all the devices in your house will work as a whole to find the most efficient and inexpensive ways to use energy,” says Miriam Horn, director of EDF’s smart grid initiative. This is not fantasy; corporations and entrepreneurs are already working on the hardware and software needed to knit our homes into energy management systems that communicate with us and the grid.

Much of this technology will simply reduce waste. Horn notes, for example, that about one quarter of the electricity we pay for is lost because appliances operate when they’re not needed. Water heaters keep water hot overnight, while refrigerators cycle on and off. In a smart grid, your house could be programmed to heat water for the morning shower, then turn off the heater until you return from work. The fridge could shut down overnight and, like an icebox, still keep food cold.

In a typical smart grid home, the appliances will talk to each other and to the grid, which



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On the grid: Eli Haslanger and Amy Atchley, with daughters Paris and Ellie, on the stoop of their Mueller house.

will be constantly adapting to changes in supply and demand. Rooftop solar electric panels might monitor the morning weather report to calculate how much energy they'll produce that day, then set up a schedule for when and how it will be used or sold. "On a hot Saturday afternoon," Horn says, "while you're swinging in your hammock, your solar panels will be charging your hybrid electric car and selling excess electricity to the grid."

If you decide not to go out that night because it's too hot, Horn adds, "your house will know, because the cost of electricity is high, to run the air conditioner off the car battery." All this will help the grid meet demand spikes without cranking up a fossil-fuel power plant.

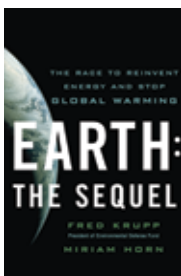
"People will actively manage their energy use more and more," says Professor Webber, who sits on the executive committee of the Mueller project. "We'll choose what we use, when we use it and how much we use."

Getting to Know You

The quiet Mueller neighborhood certainly doesn't look like the site of a revolution. Houses and apartment buildings are set close together, with porches, back alleys and sidewalks to encourage walking and visiting. Eventually, some 10,000 residents will live here, with an equal number working in the commercial areas.

From the start, residents say, there was a strong sense of community in Mueller. Frequent block parties are one expression of it; the Pecan Street Project is another. "Our energy usage makes me nervous about our kids' future," says Amy Atchley, who lives in the neighborhood with her husband and two children. "I'm hoping that our smart grid project is just the beginning, so it won't be a special thing. It will just be what everyone does."

She and her husband also hope that the project, by making energy cheaper and more abundant, will democratize access to it. "I know people who have to choose between paying for heat or buying groceries," says Atchley. "Part of what inspires this project is that we should be



Right Book, Right Time

Earth, the Sequel: The Race to Reinvent Energy and Stop Global Warming, by EDF's Fred Krupp and Miriam Horn, helped shape Austin's Pecan Street smart grid project. Brewster McCracken, PSP's executive director, says that after reading it, "I went back to the project working group and said, 'They're laying out the roadmap for us.' We decided we needed EDF and reached out to Jim Marston in July 2008. A month later, he came back and said, 'We're in.'"

Electrifying the Economy

“From 2000 to 2010,” says Jose Beceiro of Austin’s Chamber of Commerce, “the city lost roughly 30,000 high-tech jobs.” Smart grid technology, says Beceiro, a Pecan Street Project founder, could restore them.

Take Incenergy, an Austin start-up founded in 2009. It designed the energy monitoring devices in the Mueller neighborhood smart grid. CEO Barry McConachie says his company, whose products allow for remote control of electricity use, employs 15 people and is growing rapidly.

“Energy is a \$1.3 trillion industry in the U.S. alone,” says Prof. Michael Webber at the University of Texas. “I see smart grids as a huge economic growth engine, just as when we built the grid 100 years ago.”



Incenergy’s Barry McConachie, showing company software that tracks household energy usage.

doing a better job of meeting the basic needs of everyone in our community.”

The chance to be the first people to test new technologies is also alluring, says Kathy Sokolic, a geologist and Mueller resident. “This neighborhood has a lot of techies, computer people and engineers, and I think they can’t wait to get their hands on these things,” she says.

Oddly, utilities know very little about how customers use electricity or their appliances, says Isaac Barchas, a Pecan Street founder and director of the Austin Technology Incubator at the University of Texas. “Decisions about how to spend hundreds of billions of dollars on upgrading the grid are being made right now,” he says. “And they’re being made without any real knowledge about how people will interact with those changes.”

That will soon change. In February, Pecan Street finished installing wireless energy monitoring devices in the homes of 100 Mueller volunteers. This is the first step in the project’s five-year plan. The data will be collected for a year and analyzed with help from the supercomputer center at the University of Texas and EDF’s own experts. Barchas says that technology companies, utilities and policymakers are already clamoring for access to this data.

The energy monitors, designed and installed by Incenergy, an Austin-based start-up, measure where, when and how homes consume energy. This information can be displayed on smart phones in real time, says Shane Mericle, Incenergy’s chief operating officer. “You can see when clothes dryers, air conditioners, microwaves or refrigerators are running,” he says. “You can even see when someone turns on a light and how efficient that bulb is.”

Pecan Street will use this data to help with the next step: testing smart appliances, user interfaces and electricity pricing alternatives in about 1,000 homes in and around Mueller. The project has issued an open request for proposals from companies for products and energy management systems. There are also plans to install solar panels on more homes and on the roof of at least one large commercial building. These devices will help Pecan Street—and Austin Energy, the city-owned electric utility—learn how to integrate power from multiple sources into grid operations.

It's possible that even more exotic energy sources will eventually be tested. Solar roof shingles are already a reality, and solar paint is not far behind. Even roads are becoming capable of producing power, using materials that, when compressed, convert the mechanical energy of moving vehicles into electricity.

Searching for the Killer App

Pecan Street researchers will also test apps and interfaces that make it easy for homeowners to control their appliances and monitor home energy use, just as Mick's car tracks his gas mileage.

"There's no beginning and end to this project," McCracken says. "Information technology, as we embed it into homes and offices, will alter how we live." For example, he suggests refrigerators will not only manage their power consumption, but also scan the items they store, so your smart phone will be able to tell you you're running short of orange juice and order more from the supermarket.

"I'm optimistic that we can create an energy system that is cleaner, more resilient, more affordable, longer lasting," says Professor Webber, from the University of Texas. "The Mueller folks really buy into that big picture. They get that if we do this as a community we will benefit and then the world as a whole will benefit."



In Austin's Mueller neighborhood, residents will soon have a chance to try out advanced household technologies that the smart electrical grid will make possible.

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