



Annual Report
FY 2018-2019

pecanstreet.org

From the Board Chair

Looking back over Pecan Street's first decade, I am struck by the impact of our people-centered and data-driven model for environmental solutions.

When we started this experiment, we thought there would be a Pecan Street-type research organization in every major community by 2020. But it turns out this type of community-based technology development platform is incredibly difficult to replicate. The dedication of Pecan Street's staff, its Board of Directors, our partners, and, most of all, our army of volunteers has produced magic. Year after year, the work of this team sits at the vanguard of technology development and environmental solutions.

Problems get solved when companies listen to people, researchers listen to industry, and startups are given equal footing with big corporations. The Pecan Street model enables this critical feedback loop while maximizing the ubiquity of data and big data analytics for public benefit.

FY 2018-2019 was a year of exceptional growth for Pecan Street. We expanded our research network to include new testbeds in New York and California, elevated the sophistication and impact of our data resources, and scaled our research from a focus on homes to a focus on community-scale solutions.

We also launched a fourth area of work: natural climate solutions. As the world continues to blow past every scientific recommendation for emissions reductions, our planet's ability to rapidly absorb carbon looks to be our best hope to solve the climate crisis. Scalable solutions that allow humanity to tap into this potential remain the provenance of science fiction.

Pecan Street's ability to rapidly merge the latest advances in Internet of Things (IoT), low-cost sensors, real-time data analytics and artificial intelligence with cutting-edge scientific research may be the key to unlocking this path forward. With the support of our funders and partners, we are beginning to accelerate the cycle of innovation for EarthTech.

It's a pleasure to work with Pecan Street and our wonderful network of partners, and I look forward to what we will accomplish together over the next 10 years.

Sincerely,



James Marston
Chairman, Pecan Street Inc.



From the CEO

This annual report is a special edition that shares highlights from our first 10 years, including a recap of activities from the past fiscal year (FY 2018-19).

The Pecan Street team had a lot of fun thinking back on everything we've accomplished so far — including the things we “failed fast” at. Our staff picks for Top 10 achievements are listed on pages 4 and 5. I hope you enjoy reading about these projects as much as we enjoyed working on them.

FY 2018-19 is best characterized as a year of growth. We expanded to the East and West coasts with the dual goal of enhancing the geographic diversity of our datasets and creating regional research networks in New York and California. In 2019, we opened a satellite office at the Los Angeles Cleantech Incubator, marking an important milestone in the organization's growth.

At the urging of our philanthropic partners, we expanded our areas of work from energy, water and transportation to include natural climate solutions, with an initial focus on soil carbon sequestration. We also sought to deliver more impact by directly producing reports that use Pecan Street's unique datasets to address critical industry questions. This impact strategy was affirmed by the broad response to our seminal *Electric Texas* report and our *Program-Related Investments Toolkit* — both of which can be downloaded at pecanstreet.org.

I look forward to the next 10 years of innovation, creativity, and scientific breakthroughs. Thank you to our partners and supporters who make our work possible, particularly to the Alfred P. Sloan Foundation, for its ongoing investment in growing Pecan Street's impact.

If you would like to learn about how you can join and support our work, please don't hesitate to contact me or my team. You can sign up for project updates through our website, where you can also find a database of peer-reviewed publications that use Pecan Street's data. With over 200 publications in the database so far, it's a great resource of leading academic research in climate, resiliency, and electrification. I look forward to hearing from you.

Sincerely,



Suzanne Russo
CEO, Pecan Street Inc.



Leadership

STAFF

Since hiring its first executive director in 2009, Pecan Street has built a balanced team of data scientists, entrepreneurs, researchers, coders, city planners, lawyers, engineers, and consumer product experts. We've also relied on experienced contractors and consultants to expand our capabilities in new research areas and markets.



Suzanne Russo
CEO



Fisayo Fadelu
CFO & General Counsel



Scott Hinson
CTO



Rachel Jenkins
Director of Operations



Iga Hallberg
Head of Corporate Development



Steve Mock
Data Manager



Colin Rowan
Director of Communication

BOARD OF DIRECTORS

Pecan Street is governed by a board of directors that reflects the expertise and diversity of disciplines of our staff, partners and supporters.

- Jim Marston (chair), Environmental Defense Fund
- Dr. Michael Webber (vice-chair), The University of Texas at Austin
- Debbie Kimberly (secretary), Austin Energy
- Cora "Corky" Hilliard (treasurer), Hilliard Resources
- Callie Taylor, Greater Austin Chamber of Commerce
- Dr. Todd Cowen, Cornell University
- Dr. Emma M. Stewart, Lawrence Livermore National Laboratory
- Mitch Jacobson, Austin Technology Incubator
- Jimmy Flannigan, Austin City Council
- Myron Stout, Goldman, Sachs & Co. LLC

A Decade of Research, Invention and Innovation

At Pecan Street, our mission is to accelerate innovation in climate and conservation solutions. Our research, data, and technology expertise give researchers, entrepreneurs, policymakers, and impact investors the insight they need to change the world. Over the last 10 years, we have focused on three key areas: energy, water, and transportation. Progress within each of these areas is detailed throughout this Annual Report.

Our impact, however, is greater than the sum of our individual departments. In addition to producing valuable research insights, we have pushed climate action forward and changed the very nature of energy and water research. Below are quick recaps of what we have accomplished so far — You can read more about each of these impacts on our website at <http://bit.ly/PecanStreet10>.

1. An Army of Citizen Scientists

The core of our research is our network of individual households that participate in our groundbreaking research. More than merely research subjects, these individuals and families have become America's first Army of Citizen Scientists and have been featured in *Time*, *PBS News Hour*, *The New York Times*, YouTube's *Fully Charged*, and other local, national, and international media.

2. A Global Model for Community-Driven, Data-Driven Research

We didn't realize we'd blaze a trail in the research world. But the more questions we asked, the more we realized we needed to invent a whole new category of research. You can call it a digital focus group or a national field trial. We call it the future of energy research.

3. The Mother of All Energy and Water Databases

More than 2,500 university researchers have used Dataport, our online portal for the petabyte of energy and water data we've collected over the last decade. It's the largest database of its kind on the planet and has been cited in more than 200 peer-reviewed papers since its launch.

4. An Innovation Lab in the Heart of Texas' Innovation Capital

We designed our commercialization lab to be a maker's workshop, a place for energy-focused engineers and entrepreneurs to invent and test the technology that will reduce emissions, clean our air, reduce energy bills, and spark the future of smart energy.

5. A Real-World Plug and Play Technology Test Bed for Innovators Around the World

Our research network is a unique asset for data hounds and number crunchers around the world that can't find high-resolution energy and water data anywhere else. But it's also a fast-ramp, plug-and-play test bed for companies that need to field-test their smart home, energy efficiency, solar energy, or water conservation technology in real homes with real people.

6. Groundbreaking Insights into Clean Energy and Water Conservation

We produced analyses that demonstrate how installing more west-facing solar (instead of the usual south-facing solar) is a better way to reduce peak demand during summer. Our Blu suite of smart water solutions illustrated that a leaky toilet flapper is probably the biggest water waster in a house. And remember when people worried that too many electric vehicles would crash the grid? Our research demonstrated that charging behavior is malleable and manageable.

7. Helping to Ensure the Climate Transition is Just

Renters are notoriously underrepresented in energy efficiency and renewable energy research. So are low-income families. But they care about climate change, too, and they represent a significant portion of American households. Pecan Street has worked to bridge this critical data gap and include them in our research.

8. Putting People and Privacy First in a Data-centric World

Measuring, recording, and storing a family's energy and water use requires very strict rules about privacy and security. When we started, however, there were essentially no privacy or data standards for energy or water use data. So we invented them. Further, we created a DOE-approved cybersecurity policy that ensures our participants' data and anonymity are preserved and protected.

9. Expansion From Austin to New York and California

Our research network started in Austin's Mueller community and eventually expanded to other parts of Austin and Texas. We've since expanded into New York and California, which will help us learn about different climate regions with different energy use profiles.

10. Converging Academia, Citizens, Utilities, Foundations, and Tech Companies around Solutions

Reducing climate emissions is an all-hands-on-deck challenge. We've convened some of the most capable, powerful, inventive, and ambitious hands on the planet, from academic researchers and research universities to environmental policy experts and major utilities and tech companies.

Partnerships

FUNDERS & PARTNERS

Many thanks to the funders and strategic partners that make Pecan Street's work possible:

- Austin Energy
- Austin Technology Incubator
- Austin Water
- City of Austin
- City of Fremont
- Capital Metro
- CleanTX
- Cornell University
- Energy Foundation
- Environmental Defense Fund
- Landis+Gyr
- Lawrence Berkeley National Laboratory
- Lawrence Livermore National Laboratory
- LG Electronics
- Shell
- Alfred P. Sloan Foundation
- Stanford University
- TEPRI
- Translational Research Institute
- U.S. Department of Energy
- The State of Texas
- The University of Texas at Austin

Pecan Street continues to forge partnerships with the entities that shape our society, including universities, established and startup companies, public institutions, and citizens.

Pecan Street was born at the University of Texas at Austin and has extended our university partnerships across Texas and the rest of the country. In 2018, we established strategic partnerships with Stanford University, UC Berkeley, and Cornell University to take full advantage of our expanding research network in California and New York. Our network of university-sponsored researchers now includes more than 2,500 researchers from more than 60 countries around the world.

Our original partnership with Austin Energy has evolved and strengthened. In 2019, we led a key component of the utility's Department of Energy-funded Austin SHINES program, which evaluated the performance of residential, community, and utility-scale energy storage.

As Pecan Street grew from a local startup to a research pioneer, we became a key source of data and analysis for tech startups and established corporations. LG Electronics, Sony, Oracle, Itron, Landys+Gyr, Shell, Eaton, and Direct Energy have worked with our data, our staff, or both.

Partnerships, cont'd

To fulfill our mission of accelerating innovation for climate and conservation solutions, our team realized early on that we needed to find a way to support startups as well as large companies. Startups are where disruptive, leapfrog solutions are usually born, and helping them accelerate their technology development, verification and market adoption process is critical.

Across 2017 - 2019, Pecan Street's PLATFORM for Product Launch, funded in part by the Department of Energy, worked with 20 startups to validate and optimize their innovations. PLATFORM is informed and guided by Pecan Street's Innovation Advisory Council, which provides critical insight into market and funder trends as well as community needs. We also worked with a variety of impact investors to understand how we can get more investment flowing to promising cleantech startups. As a result of this exercise, Pecan Street developed and released the *Program-Related Investment Toolkit*, which helps foundations direct more of their funding to market-based solutions that have the potential to produce catalytic change.

The **Innovation Advisory Council** included:

- Christophe Defert, Centrica Innovations – Ventures
- Sergej Mahnovski, Edison International
- Tilak Gopalarathnam, LG Electronics
- Kirk Coburn, Shell Ventures
- Isaac Barchas, Translational Research Institute
- Jason Ballard, ICON3D
- Melissa Uhl, Elemental Excelsior
- Bomee Jung, NYC Housing Authority
- Sarah Richards, Cynthia & George Mitchell Foundation
- Gregory Lopez, Leonardo DiCaprio Foundation
- Benjamin Gaddy, Clean Energy Trust

Partner Spotlight: Lawrence Livermore National Laboratory & Cornell University

Thanks to a \$1.2 million grant from the Alfred P. Sloan Foundation, Pecan Street expanded its groundbreaking home research network into New York and California in 2019. Lawrence Livermore National Laboratory (LLNL) and Cornell University's Atkinson Center for a Sustainable Future each provided an additional \$150,000 to support the creation of these regional research networks. In addition to providing important geographic and climate diversity to Pecan Street's datasets, these regional research networks will provide critical testing grounds for innovations in clean energy policy and technology.

LLNL and Cornell researchers are working closely with Pecan Street staff to engage regional stakeholders in the design of each testbed, scope research projects opportunities, recruit participants, and provide logistical support. LLNL's Dr. Emma Stewart and Cornell's Dr. Todd Cowen each joined our Board of Directors last year and will help us capitalize on these new partnerships.

In New York, the research network is already supporting Dr. Cowen's NSF-grant funded research project on optimization of smart electric meter networks. In California, Pecan Street is partnering with LLNL on several research projects, including the creation of a smart meter research system that detects and resolves cybersecurity threats, advanced energy efficiency analysis, and distributed grid intelligence technologies.

Finances

In fiscal year 2019, the organization principally focused on executing contracts awarded in the prior fiscal year (2018). Our major funding sources remained the same, namely the Alfred P. Sloan Foundation, the U.S. Department of Energy (DOE), and corporate entities.

UNIVERSITY OF MICHIGAN SUBAWARD

In the last quarter of the fiscal year, the organization was named sub-awardee to the University of Michigan on a DOE award. The \$818,500, three-year grant to Pecan Street will fund development and field-testing of aggregator software aimed at demonstrating the viability of low-cost, large-scale commercialization of non-disruptive thermostatically controlled load control strategies.

MAJOR SPONSORED RESEARCH PROJECTS

Two major U.S. corporations contracted with Pecan Street on sponsored research projects for \$200,000 and \$126,000. These contracts funded the development of disruptive technologies designed to provide innovative services to the power grid and enhancements to the energy monitoring devices installed in Pecan Street's residential energy testbed homes.

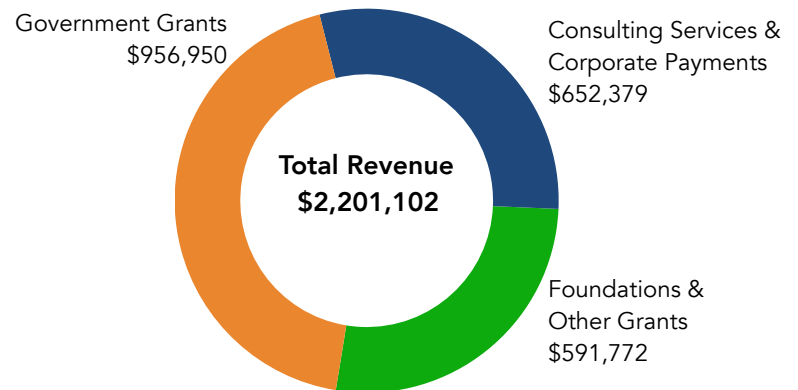
FOCUS ON ENERGY AND TRANSPORTATION

The organization incurred \$2.1 million in operating expenses. Energy programs made up an overwhelming percentage of efforts at 90%, compared to 10% spent on transportation activities.

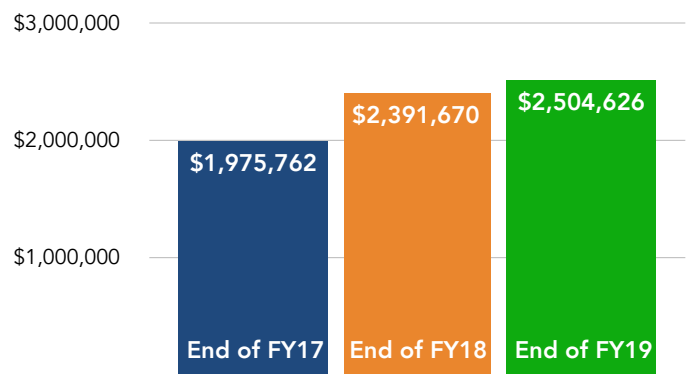
INCREASED NET ASSETS

The organization's net assets grew 5% (\$112,956) during the past fiscal year. This increase is primarily due to additional corporate-sponsored research projects and licensing royalties.

FY 2018 - 2019 Revenue



Net Assets



2018-2019 — A Year of Expansion

Pecan Street launched its residential energy and water research network in Austin's Mueller neighborhood in 2010, where we spurred the installation of nearly 200 rooftop PV systems and the purchase or lease of more than 70 electric vehicles. We expanded to other Austin neighborhoods and, eventually, to areas outside Austin and Texas. Since 2010, we have installed research equipment in more than 1,100 homes — more than 600 of them are currently providing energy and/or water data to our database.

Last year marked our most ambitious expansion yet. Our Texas-heavy research is already a unique data resource for researchers around the world. But expanding into other areas with different energy profiles, weather patterns, and generation resources will allow us and our partners to ask more questions, test more technologies, and learn more about how we can reduce emissions everywhere.

Thanks to a generous grant from the Alfred P. Sloan Foundation, Pecan Street was able to expand into New York and California. In Tompkins County (near Ithaca, NY), we have already connected more than 100 homes with an impressive mix of energy technologies: 71% have rooftop or ground-mounted

solar, 29% have EVs, 24% have both. This high penetration of solar and EVs will give our researchers first-of-its-kind insight into how these technologies work in a cooler, more northern climate.

Expanding to different climates with different energy profiles allows us to tackle new research questions critical for these two states to move forward with their aggressive clean energy goals.

Installations in California's Bay Area are underway and are expected to be completed by the middle of this year. Together, our new participants in New York and California will add 200 homes worth of data to our energy use database.

The Sloan Foundation grant allowed Pecan Street to expand our research capabilities in existing participants' homes by upgrading our equipment to collect data every second rather than every minute and collect a variety of data points from each circuit. It also allowed us to develop a comparative ISO emissions and pricing research portal as well as a robust plant-to-plug visualization toolkit.

“With Pecan Street’s technology, we can see our electricity use in real-time and find opportunities to make better energy choices. And we’re happy to be contributing to a body of knowledge that’s available to researchers around the world.”

— Charles Eldermire, Pecan Street Participant, Tompkins County, NY

Research Spotlights



Most of the attention Pecan Street receives falls into two categories: our network of real-world research participants and the massive database we created from our participants' energy and water use. For researchers around the world, each is a one-of-a-kind resource.

Our network and data are also unique assets for companies of all sizes that need to test their technologies in real-world settings or verify their products with real-world energy and water data. Over the past 10 years, we've worked with global brands you've heard of, like LG Electronics, Eaton, GM, and Sony, on products ranging from HVAC load management hardware to electric vehicle charging to home automation.

We've worked with dozens of startups, too – companies that you may not know now but who are working on the innovative technologies that will provide

leapfrog solutions to reduce emissions, accelerate the use of clean energy, and save water.

Each of Pecan Street's core assets – our lab, our network, our data – are unique by themselves and have helped companies answer questions or prove out technologies that would have taken much longer and more money to do alone. Together, however, they make an even more powerful difference for companies that are trying to invent the future of energy and water management.

“There's no better testing lab than the real world. Pecan Street has a unique and unmatched suite of testing and verification capabilities that will help our team deploy this exciting tech in real homes.”

— Wei Ren, Eaton

Spotlight: Energy Research



In its first 10 years, Pecan Street has set the standard for real-world energy research.

Pecan Street's energy research helps corporations, entrepreneurs, and policymakers develop solutions that accelerate the transition to clean energy. Our team specializes in modeling, testing, and verifying distributed energy resources, smart home technologies, electricity pricing, and the infrastructure required to support increased renewable energy.

Pecan Street's first notable project was our 5-year Energy Internet Demonstration, a \$30 million project that was funded through a \$10.4 million grant from the Department of Energy, \$14 million from in-kind support provided by a robust coalition of Austin's leading institutions, and \$5 million of in-kind support provided by industry-leading corporations, including LG Electronics, Landis+Gyr, Sony, Dell and Intel.

We seeded our testbed with a dense distribution of distributed energy, electric vehicles and Home Energy Management Systems (HEMS) that collected data on the consumption patterns and how those patterns change in response to new technologies and/or behavioral interventions.

This founding demonstration project produced various research milestones, including:

- interoperability architectures for distributed energy resources, smart home technologies, smart meters, and home area networks
- the world's largest residential energy and water research database and the underlying open-platform, researcher-optimized database architecture
- a privacy standard for customer-side data
- a secure smart meter research network across 250 homes

GLOBAL IMPACT

Pecan Street developed, hosts, and maintains the largest energy use database on the planet and makes it available to researchers around the world through Dataport. Collecting more than a billion records per day, Dataport has been used by more than 2,500 university-sponsored researchers from more than 60 countries, and has been cited in more than 200 peer-reviewed journal articles.

INSIGHTS ACROSS DISCIPLINES

Our energy research has also yielded unique insights that cross the technology, energy, and policy sectors, including:

- Behavioral trials showed that proactive recommendations to consumers can have measurable impacts on energy usage, even without monetary incentive.
- West-facing solar generation aligns more closely with peak-demand than south-facing solar. Utilities in the Sunbelt region should consider providing a higher rebate for west-facing systems to provide greater benefit to the utility and grid.
- Homes with energy efficient technologies, such as compact fluorescent lighting, variable speed drives and switching mode power supplies have unintended power quality consequences when paired with a high density of residential solar. Storage installed at the point of generation can mediate power quality of the home, reducing the burden on the utility to supply reactive power.
- EV charging is more distributed across the day than was anticipated, and owners are willing to modify their charging times to occur outside of peak hours if incentivized through variable pricing models or conservation messages.
- Open-platform grid management services have the potential to rapidly add intelligence to the grid, resulting in a more efficient and reliable energy system.

Decentralized energy production and management can increase grid resiliency, reduce the need for costly upgrades to centralized grid infrastructure and offer more services that leverage distributed, renewable energy resources. Utilities and communities in other areas of the country can build upon the framework created by Pecan Street to establish their own research and development testbeds that will reveal local solutions for energy management.

ENERGY STORAGE

Pecan Street is proud to be part of Austin SHINES, an innovative program led by Austin Energy that is driving forward progressive energy storage solutions.

Made possible by a \$4.3 million grant from the U.S. Department of Energy and support from the Texas Commission on Environmental Quality, the project was designed to optimize the value of solar and storage for grid, commercial, and residential applications.

Pecan Street managed the residential portion of the project, which included conducting research into how "smart" solar systems and energy storage — including vehicle-to-grid technology — can help make Austin's power supply cleaner, cheaper, and more resilient.

Pecan Street deployed residential gateways to perform the necessary communication and protocol conversion for the aggregation of a fleet of residential energy storage systems, as well as the energy monitoring hardware used to validate and verify system operation. This hardware enabled the systems to respond to aggregated charge or discharge commands and bring the entire fleet of residential storage online in less than eight seconds.

We discovered that the OpenADR-compliant platform for aggregation of DERs can provide a utility with critical flexibility to determine which DER management solutions to allow on its grid. This approach also allows for faster modular additions as new DER technologies, like vehicle-to-grid services, emerge and evolve. Austin SHINES demonstrated how aggregated DER management solutions can provide more community-wide benefits and household-level benefits, in addition to independent system operation benefits.

Energy Research — Looking Forward

THE FUTURE IS SMART DERs

Last fiscal year reinforced Pecan Street’s assessment that maximizing the potential of clean, renewable electricity will depend on the optimization of distributed energy resources. And that, in turn, will require manufacturers, utilities, and service providers to increase the intelligence of DERs at the edge of the grid.

Existing DERs perform well, but are tasked with only a fraction of their potential. They currently operate as disparate, independent elements that do not easily connect to each other. Because of this independence, none of them are tasked with managing, optimizing, or coordinating functions that would maximize a customer’s total investment. Today, an EV, rooftop PV, a smart thermostat, and even stationary storage are far less than the sum of their parts.

Exhibit A: Distributed vs. Centralized Storage

Through the Austin SHINES project, Austin Energy and Pecan Street demonstrated that distributed storage resources could be quickly and reliably dispatched when called upon by a utility. During ERCOT’s 4CP event in June, Austin Energy was able to discharge 45kW of residential storage — a potential savings of more than \$16,000 for Austin Energy from only seven homes. Extending storage to the grid edge also creates stability for utilities because, unlike storage at a substation or transformer, the failure of a single residential storage device does not affect large numbers of customers.

Exhibit B: EVs As Rolling Power Plants

Electric vehicles can be more than gasoline engine replacements. Their large batteries can provide quick

relief to the grid if they are configured to — and allowed to — send power back to the utility. The challenge is in integration and smart interoperability. In 2019, Pecan Street installed Texas grid-connected vehicle-to-grid (V2G) charging infrastructure at its lab in Austin, making it the first location in Texas that can dispatch energy from an electric vehicle back to the grid when needed.

To meet the utility’s needs as an energy resource and reserve enough charge within the car for it to provide an average household’s needed mileage, Pecan Street created a custom software interface between the car and the V2G system. EV manufacturers, charger manufacturers and utilities do not offer such a software interface, rendering every EV on the road a missed opportunity to relieve peak demand and increase community resiliency to outages.

Exhibit C: Automating Customer Demand Response

For the past 10 years, utilities have been deploying various residential demand response programs to curb peak demand and stay within capacity limits. These programs primarily relied on smart thermostats that allow the utility to delay home heating or cooling during critical periods.

As with EVs, existing programs fail to maximize the full potential for residential demand flexibility. Our work with Eaton, the University of Michigan and MIT / Lincoln Lab is applying advances in IoT and insights from Pecan Street’s high-fidelity data to create next-generation demand response programs that are smarter, automated and work on the timescale needed to match loads with DER intermittency.

Spotlight: Transportation Research

Pecan Street conducts research of EV adoption, vehicle-to-grid integration, and the electrification of public transit.

As more cities pursue low-carbon strategies, our transportation sector is facing an electric future. That means utilities, researchers, and policy-makers need a better understanding of how our grid will be impacted and what steps we should take to prepare for this shift.

Even with an electricity fuel source that is dependent on coal and natural gas, converting transit from gas or diesel to electricity would yield significant climate emission reductions. As our nation's electric grids transition to a renewable energy mix, the potential of electric transit becomes even clearer.

EV CHARGING RESEARCH

In our first year of operation, we incentivized a group of our volunteer households to lease or purchase plug-in EVs, creating the densest network of residential EVs in the country. Each of these homes was instrumented with Level 2 charging systems that are independently monitored for real-time reporting on energy use. This dataset has resulted in several academic publications on EV charging and charge management approaches.

The testbed enabled our team to conduct a suite of technology and behavioral research projects that validated the value proposition of EVs to utilities and their potential to support a distributed, clean-powered grid.

Through partnerships with GM/OnStar and Schneider Electric, Pecan Street evaluated technological and business model opportunities to optimize residential EV charge management intelligence for grid system benefits and for household benefits.

INTELLIGENT DEMAND RESPONSE

In partnership with EDF, we created and demonstrated intra-home and inter-home load management strategies that balance HVAC use and EV charging to stay below a total instantaneous energy use of 10kWh and to absorb excess PV generation from neighbors' roofs.

With the Center for Commercialization of Electric Technologies, we tested a variety of utility rate structures and evaluated which and to what degree different pricing programs resulted in emissions reductions or cost savings.

In 2020, we will complete the Electric Last Mile (ELM) research project in partnership with the City of Austin, Austin Energy, and Capital Metro. This project leveraged our community research networks and data collection capabilities to identify and demonstrate new community micro-transit models.

Now, through funding from the Alfred P. Sloan Foundation, we are growing our EV data and scaling our electric transit research network to include new homes with EVs and solar in New York and California.

Spotlight: Water and Soil Research

Pecan Street is leveraging its experience in water research to spur a new climate frontier: soil.

Pecan Street's data-driven energy research caught the attention of the State of Texas, who asked us to apply this same approach to making water smarter. In 2014, with funding from the State of Texas' Emerging Technology Fund and the George & Cynthia Mitchell Foundation, Pecan Street convened over 35 entities to create the University-Municipal Water Consortium to investigate opportunities for application of Internet of Things technology to water management.

FROM SMARTER WATER....

Turning water "smart" required the development of new sensors to better understand where the biggest opportunities to save water existed and to monitor which conservation efforts worked. It also required building a water testing center at our lab and new testbeds across Texas.

Through the course of this work, we developed the Blu suite of hardware and software technologies — a low-cost, readily-deployable solution that turns legacy mechanical water meters into real-time, high-resolution digital water meters.

But creating new, low-cost, open platform smart water monitoring systems was only one piece of the puzzle. Water utilities, often municipal entities with very low budgets and an aging workforce, also needed simple plug-and-play solutions for data management.



Pecan Street's Blu suite of hardware and software turned legacy mechanical water meters into internet-connected smart meters.

Working in partnership with the Aspen Institute and our University-Municipal Water Consortium members, particularly San Antonio Water Systems and Austin Water Utility, Pecan Street developed an open database architecture and pre-packaged data processing and reporting codes — the Internet of Water Toolkit — to standardize data collection and storage in conjunction with interoperable, open platform databases.

In addition to facilitating the use of better data for better conservation program design, water data standardization makes it possible for researchers to rapidly compare programs and outcomes across regions and for companies to design solutions applicable across utilities, accelerating innovation and the dissemination of best practices.

Blu water data also enabled Pecan Street to conduct research for Environmental Defense Fund into the energy-water nexus and opportunities for concurrent reductions in energy and water use.

The water conservation testbed enabled performance evaluation of leak detection and mitigation technologies from eight startups, including a quantification of their water and energy savings impact if adopted at scale.

....TO SMARTER SOIL

After a yearlong investigation into the opportunities and challenges with soil carbon sequestration, we believe our model can help to accelerate the utility of this critical carbon sink. Turning agriculture into a climate solution that extracts more carbon from the atmosphere could provide global relief from climate change within the next 5 to 10 years.

Pecan Street is collaborating with various initiatives to apply our unique capabilities to accelerating soil carbon sequestration, including:

- 4p1000 Research Consortium — the world's primary convening body to accelerate soil carbon sequestration on farmlands.
- The Soil & Climate Consortium — Initiated by Pecan Street, the consortium will convene leading U.S. soil scientists with innovative entrepreneurs and industry leaders to convert breakthroughs in soil science research into market solutions.

Co-led by Cornell University and Colorado State University, we are currently completing the research timeline and rounding out membership in phase one of the Consortium.

- Cleantech Acceleration — we work with a leading group of investors and philanthropists to develop new investment tools and resources for cleantech startups.



Next to our oceans, soil is Earth's largest carbon sink. Through our work with other global soil experts, we hope to provide verification and testing capabilities to remote carbon sensing.



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