



Annual Report FY 2020-2021

pecanstreet.org



Pecan Street conducts original research that accelerates innovation in energy, water, transportation, and natural climate solutions. Our research, data, and technology expertise give researchers, entrepreneurs, policymakers, and impact investors the insight they need to change the world.

Our real-world testbed of volunteer research participants is the first of its kind on the planet and has become an international model for conducting energy and resource research and product testing. Our commercialization lab is a world-class proving ground for major corporations and startups alike. And our database, the largest source of disaggregated customer energy data, is used by university researchers and industry-leading companies around the world.

Learn more at pecanstreet.org or email info@pecanstreet.org.

# From the Board Chair and CEO

There is little question 2021 will be remembered most for the devastating human, social, and economic impact of the Covid-19 pandemic.

One of the few things the pandemic didn't slow down was climate change. From China to Germany to the United States, we experienced five \$20 billion climate disasters – flooding, hurricanes, and winter storms. Here in Texas, Winter Storm Uri froze the state for a week, crippled the state's fossil fuel-dependent electricity grid, and killed hundreds of people.

The pandemic laid bare the importance of good data and thoughtful, non-partisan, and critical analysis. The kinds of solutions that will make the biggest impact in our fight against climate change – be they policies or technologies – must be rooted in data that demonstrate their effectiveness, affordability, equity, and scalability. That's Pecan Street's sweet spot. And though we worked remotely and Zoomed through most of our research projects, our team powered through this unprecedented time and produced substantial work.

We're pleased to present an annual report that demonstrates our commitment to our mission and an unmatched expertise in the tools, analysis, and insight leaders need to combat this common challenge.

Looking toward the next year, we're simultaneously optimistic and anxious. Never have the technologies that can deliver drastic climate emission reductions been so clearly demonstrated in the real world. They're ready. But we are running out of time to stay within 1.5°C of warming. We need solutions now, at scale. We stand ready to help researchers, policymakers, entrepreneurs, and others in the climate action community understand the potential and challenges of these promising solutions.

As always, thank you to our staff, board, funders, and the scientists around the world who put our research to use and help us pursue our mission.

If you would like to learn more about our research or join our search for climate solutions, please reach out to info@pecanstreet.org.

Sincerely,

Ja Manst

Jim Marston Board Chair



Suzame Russo

Suzanne Russo CEO, Pecan Street Inc.





# **Partnerships**

# **FUNDERS & PARTNERS**

Many thanks to the funders and strategic partners that make our work possible:

Alfred P. Sloan Foundation Austin Energy Austin Technology Incubator Austin Water Utility Austin Energy City of Austin Capital Metro Cornell University Cynthia and George Mitchell Foundation **Energy Foundation Erasmus University IDEXX** Foundation Landis+Gyr Lawrence Berkeley National Laboratory Lawrence Livermore National Laboratory Michigan State University National Renewable Energy Laboratory National Science Foundation Patrick J. McGovern Foundation Texas A&M University Texas Energy Poverty Research Institute The University of Michigan The University of Patras The University of Texas at Austin U.S. Department of Energy

Pecan Street's model of change relies on partnerships with entities that shape our society, including established and start-up companies, universities, public institutions, and citizens.

## **RESEARCH PARTICIPANTS**

Our research participants are the heart of Pecan Street's work. Quite simply, we wouldn't be able to do any of our work without them. These volunteer citizen scientists contribute their anonymized energy data to be part of positive and lasting policy and technology improvements. Pecan Street is honored they choose to work with us and trust us with their data.

## **COLLABORATIONS**

In the last fiscal year, Pecan Street engaged with collaborative groups working in soils and artificial intelligence.

Soils Consortium Members

- Texas A&M University
- Cornell University
- Colorado State University
- Texas Advanced Computing Center (TACC)
- 4p1000 Initiative

#### Artificial Intelligence Working Group Members

- Agrimetrics
- Cornell University
- GSI Environmental
- Hypergiant Industries
- Indigo Ag
- International Soil Carbon Network
- Lawrence Livermore National Laboratory
- Rice University's Baker Institute
- Texas A&M University
- Texas Advanced Computing Center (TACC)
- The University of Florida
- Verra Carbon Standard

# **Mission and Program Areas**

Climate change is the world's single greatest challenge. Addressing it will grow the economy, improve people's lives, and protect our natural resources and climate.

Pecan Street's mission is to accelerate innovation in climate and conservation solutions and get them to scale faster.

Our work falls into four research areas and leverages three unique disciplines.

# **Research Areas**

## **ELECTRICITY**

Electricity is core to a strong economy and modern life. Reducing its emissions is key to solving climate change. Pecan Street was born from a commitment to redefine our energy system, and finding ways to increase the use of renewable energy and use electricity smarter remains at the heart of our mission.

### **TRANSPORTATION**

Electrifying transportation with emission-free renewable energy is a transformational opportunity to strengthen the grid and reduce climate and local air pollution. Our electric vehicle research created the densest population of consumer EVs in the country and the most robust EV dataset on the planet.

#### WATER

Water and electricity are closely interconnected. We developed custom sensors and software that turn legacy water meters into internet-connected smart meters that collect highresolution water data and can determine different in-home end uses.

#### SOIL

Our work developing custom smart water meter technology led us to soil research. Carbon sequestration under the world's cropland is a remarkable climate solution. We are working with the best minds around the world to advance soil science and measurement technology.

# **Disciplines**

## **REAL-WORLD, EMPIRICAL DATA**

With more than 1,000 members, our volunteer network of residential electricity customers is the largest and most unique real-world energy field study on the planet. Collecting electricity use data from multiple circuits in each home every second of every day, Pecan Street's sophisticated sensor network produces 7 billion data points a day.

#### **INTEGRATED BIG DATA ANALYSIS**

Our energy data is received, anonymized, and verified automatically and made available to our partners and clients through Dataport, our custom-designed data interface tool. With more than 2,000 university-sponsored users in more than 60 countries, our data has been cited in more than 300 peer-reviewed research papers.

### **TECHNOLOGY INVENTION AND TESTING**

Most of our electricity research technology – and all of our water research technology – required custom-engineered hardware and software developed at our lab in Austin. In addition to supporting our own research, our lab offers specialized capabilities for developing, testing and validating consumer electronics, building controls, solar PV, natural gas fuel cell, machine-to-machine, vehicle charging and disaggregation technologies.

# **Impact and Insights**

Pecan Street believes our work has the potential to impact everyone. But we work in a technical and wonky industry and realize that many of our analyses can seem overly complicated, even to some of the organizations that support our work.

This year, we asked our staff to cut through the tech-speak and share their most powerful takeaways from the year.

## Jill Harlow — Chief of Staff

Our work on soil carbon this year underscored for me just how important Pecan Street's human convening power is. Our soils working group brought together dozens of experts from across the country who didn't know each other or how their work was connected. The more we learn about emerging solutions that cross disciplines, the more this capability will differentiate us.

#### Fisayo Fadelu – CFO and General Counsel

I'm proud of how our team has weathered the budget and logistical challenges of Covid-19. We have remained nimble, quickly adapting to unpredictable change, and have actually gained efficiency in several aspects of our work. I think that this is a testament to how resilient we are.

## Scott Hinson — Chief Technology Officer

Many of our issues are lofty and esoteric, and we work with a lot of technical experts. But our work affects everyone, not just data analysts and energy wonks. This year reminded me how important it is to reduce our issues down to things real people care about, like how the grid works, what we need to integrate more renewable energy into the electricity system, and making clean energy more accessible and equitable. We're more committed than ever to packaging our work so people can understand how it impacts them.

#### **AK Defang – Database Administrator**

I've worked in healthcare data, and that's a pretty political industry. So I was surprised to learn how much politics – rather than data – drives renewable energy policy. I'm thrilled to be part of an organization that is pushing the ball forward on such an important issue and is committed to basing our recommendations on data.

## Steve Mock – Dir., Data & Information Services

I think this was the year the size of our database really smacked us in the face. We're running out of metaphors to explain how big and unique it is. And we're better positioned than anyone to lead on artificial intelligence and machine learning analysis because we have such a robust universe of real-life energy data to work with.

## Josey Fatzinger – Administrative Assistant

I work across every team at Pecan Street, and I'm amazed at the breadth of our expertise and our ability to pivot to new areas like soil carbon and energy equity. I think our partners think we're a lot bigger than we are because we can bring insight to the table on so many issues.

#### Luis Peña — DevOps Engineer

We manage a lot of behind-the-scenes things that even our most sophisticated data users might not know about. For example, our new messaging protocol, MQTT, is very common within the "Internet of Things" industry and allows a much simpler and more reliable way to get data straight into our servers. Researchers who use our data never see this process, but it provides them new data faster and takes a number of old tasks off our plates.

# **Sharing Our Work**

For organizations like Pecan Street, conferences and trade shows are critical venues for reaching key academic and industry stakeholders. Travel restrictions changed all that. As each wave of the pandemic disrupted traditional opportunities for knowledge exchange, we deepened our thought leadership online.

This proved to be a powerful platform for sharing our work with a more diverse audience. As we emerge from the pandemic, Pecan Street remains committed to making our work more accessible through continued free, online webinars and engaging with organizations outside our typical networks.

#### **WEBINARS & ONLINE DISCUSSIONS**

We hosted more than 20 online events on topics ranging from

# **KEEPING UP WITH PECAN STREET**

You can find more information about our work on our website, linked below.

- Events Webinars and other virtual and inperson events
- News Blogs, press releases and select media stories about Pecan Street
- Published Papers Published academic papers that relied upon Pecan Street data
- Pecan Street Reports White papers and other material published by Pecan Street

Race & Energy to Artificial Intelligence to the 2021 Texas grid crisis. We featured in-house experts who walked diverse audiences through detailed data analyses and convened outside experts who provided nuanced perspectives on our climate crises. Our past and future events are listed on our <u>Events Page</u>.

#### **PUBLICATIONS**

In-house publications became an increasingly key component of our outreach strategy. Not only did they give our staff an opportunity to share the results of our work, they emerged as an effective way for us to quickly expose critical stakeholders to the issues, challenges, and solutions examined through Pecan Street's research. The topics and complexity vary dramatically, from a detailed case study on the impact of storage systems on an ERCOT 4CP event to a white paper that offered guidelines for the Biden administration's investment in electric vehicle infrastructure. All Pecan Street publications can be found on our <u>Publications Page</u>.

#### **CURRENT EVENTS**

Most Pecan Street projects are complex, multi-organization efforts with long timelines, which makes it challenging to share our lessons learned in real time. By connecting insights from our data and research experiences to current events, we supplemented formal project reports with timely analyses and commentary to help our audiences better understand the impact our work. The two most notable examples are <u>2020's COVID stay-at-home orders</u> and the <u>2021's historic winter</u> grid disaster in Texas. In both cases, our staff quickly analyzed energy use and generation trends, produced public-facing briefing material, and hosted webinars for clients, participants, opinion leaders and media.

## **NEWS & BLOG**

Our <u>News and Blog page</u> is the most comprehensive location for all our press releases, commentary, publications, and announcements. Everything we produce, including the categories above, is accompanied with a blog post or press release that gives readers <u>one-click access</u> to all our public-facing material.

# **Program Activity**

## DATA, DATA, DATA

Pecan Street has been collecting energy data from volunteer homes for more than a decade – more than a thousand homes in total. This fiscal year, our active homes in Texas, New York, and California provided nearly 7 billion data points every day. That not only requires a lot of interaction with volunteer families, but also an astonishing amount of behind-the-scenes design and maintenance to ensure quality, security, and uptime of <u>Dataport</u>, our online data portal.

This fiscal year, DataPort had over 700 active user accounts, and our data was <u>cited in more than 50 research papers</u>. Internally, our team <u>created a library of Jupyter Notebooks</u> that streamline researchers' access to the most requested solar generation, electric vehicle charging, air conditioning, and building efficiency data, as well as a Jupyter Hub where researchers can use various programming languages to set up queries, run large analytics, and store and share their code and visualizations.

To further our <u>Digital Dirt</u> soil carbon work, we introduced new resources to DataPort, including an integrated set of soil and farm data from research institutions in the United States and the United Kingdom and a database framework designed for easy integration of data and common agricultural models. Results from our <u>Regenerative Farmer Survey</u> and Soil Researcher Survey are also included.

#### **RAPID HARDWARE & SOFTWARE DEVELOPMENT FOR CLIMATE CHANGE SOLUTIONS**

Pecan Street continues to develop custom hardware and software that turn researchers' equations and computer simulations into real world solutions. This year, we collaborated with <u>the University of Michigan, UC Berkley, and Los Alamos</u> <u>National Lab</u> to design a device and custom software to interpret instructions from the research team's offsite controllers, assess real-time home temperatures, and control cooling systems remotely. Aggregating and coordinating the response of many homes offers a cost-effective way to balance load on the electric grid without inconveniencing families. Successful test installations have already demonstrated the feasibility of this solution, and 100 Austin homes will participate in a full field trial this summer.

## **COMMUNITY-CENTRIC TECHNOLOGY FIELD TRIALS**

Pecan Street often facilitates novel partnerships to demonstrate promising technology solutions in the field. Our project with Capital Metro (Austin's public transportation authority) concluded this year, illuminating the benefits and feasibility of using small electric shuttles for first-mile, last-mile, and local transit connections. As part of this effort, we <u>developed a</u> <u>guide to help transit authorities and campus officials</u> plan for the introduction of autonomous vehicles.

We also continued our long-standing collaboration with Eaton to forecast distributed energy reserves and field test technologies to manage electric load. This partnership led to an opportunity to add 25 Delaware homes to our research network in 2022. We also supported Itron's efforts to test the functionality and communications capacity of one of its new smart meter designs.

# **Program Activity, continued**

#### DEMOCRATIZING RESEARCH WITH ADVANCED DATA VISUALIZATION

The Pecan Street team increasingly engages in original analysis and data visualization to support high-impact projects and produce recommendations to guide policy or technology development. This year, we modeled peak energy demand and solar production to help the Electric Power Research Institute pioneer a solution to use solar+storage to restore power to isolated portions of the grid. We produced an <u>online, interactive tool</u> that visualizes how adding electric appliances and vehicle chargers may be a challenge in homes with smaller electrical panels. An <u>accompanying white</u> <u>paper explored the opportunities</u> for policymakers and utilities to remove this significant barrier to residential electrification. Another analysis demonstrated how <u>correcting residential power factor</u> could significantly increase transmission and distribution capacity without infrastructure upgrades.

# STUDENT INNOVATION TO SOLVE WICKED PROBLEMS

We constantly seek pathways to engage the creative energy of students in solving some of society's most wicked challenges. This year, <u>Pecan Street hosted a global competition</u> for university students to develop a robust Vehicle-to-Grid (V2G) control algorithm to optimize residential fleets of electric vehicles for grid decarbonization and increased resiliency. More than 30 teams from 11 countries and 26 universities received complimentary access to our datasets and participated in the competition. Shanshan Liu and Xi Cheng from the University of Illinois at Urbana-Champaign received a \$2,500 prize for a model that manages EV charging and discharging depending on grid conditions and addressed rooftop solar intermittency by identifying when an EV could be used as energy storage system. Lui and Cheng's solution holds potential to decrease emissions and help electricity customers save money.

### **INNOVATING ENERGY DATA GOVERNANCE WITH NEW YORK STATE**

In 2021, Pecan Street was selected to serve as the <u>Utility Data Advisor</u> for a visionary effort to create a centralized platform where a variety of certified providers will be able to access data from across all of New York State's regulated utilities to accelerate the deployment of clean energy solutions and facilitate analysis of grid insights to inform policy, investment, and operational decisions. Pecan Street will advise the Department of Public Service and Energy Research and Development Authority (<u>NYSERDA</u>) to guide the sourcing of data from utilities across the state. Ultimately, this effort is expected to support New York's goal of 70% of the state's energy to come from renewable resources by 2030.

#### **PUSHING FOWARD ON SOIL CARBON**

Carbon capture and sequestration is a critical part of the climate solutions toolbox, and we're doing our part to realize the climate potential of agricultural lands. This year, we explored the potential of machine learning to deliver reliable, cost-effective measurement and verification solutions that will unlock new markets and revenue opportunities for farmers and ranchers. We convened an interdisciplinary AI for Soil Carbon Sequestration Working Group of soil scientists, data scientists, economists, and carbon market managers. We published an <u>R&D Roadmap</u> based the group's recommendations that describes tools necessary for catalyzing markets that value and support farmers in producing ecosystem services along with food. In addition to the results of an <u>initial farmer survey</u>, our data team added several public soils dataset onto Dataport to improve access for future research.

With new funding from the National Science Foundation's Smart and Connected Communities Program, we partnered with researchers at Cornell University and Colorado State University to explore where farmers go for information and support when considering beneficial practices like maintaining continuous plant or residue cover, minimizing tillage, and diversifying crop and livestock rotations.

Soil carbon will play an increasingly important role in climate discussions, and Pecan Street's staff and board believe it is an opportunity to elevate the importance in climate justice discussions, too. New funding from the U.S. Department of Agriculture will expand this work in 2022.

## **EXPANDING EXPERTISE ON RACE, ENERGY & CLIMATE JUSTICE**

Since the launch of the Center for Race, Energy & Climate Justice, we have listened, learned, shared, and forged new partnerships to address complicated equity challenges. Our <u>white paper on the Race and Energy Nexus</u> – featured by Canary Media as one of its top resources for the energy industry in 2021 – illuminated the need to think differently about energy affordability and insecurity, the siting of power generation, and the jobs and economic opportunity associated with the transition to clean energy.

CEO Suzanne Russo joined the <u>Energy Equity Project</u> working group, organized by the University of Michigan's Urban Energy Justice Lab, that is designing a framework to evaluate energy equity in all communities across the country. We hosted a symposium series to help small environmental justice organizations prepare to seek federal funding and provided technical assistance to the Solutions Project's Justice 40 Accelerator. With Huston-Tillotson College in Austin, <u>we</u> <u>developed a toolkit</u> to help Historically Black Colleges and Universities (HBCUs) evaluate and participate in clean energy markets and serve as resiliency hubs for surrounding communities. And we secured funding and partnerships to expand our research network in Detroit and Puerto Rico, beginning a critical effort to bridge the <u>energy equity data gap</u>.

Our <u>soils R&D roadmap</u> highlighted the need to integrate farmers and ranchers of color and female food producers early in conversations around carbon and ecosystem market design. Building on this report, Pecan Street is managing and participating in multiple projects that seek to close the racial divide in access to economic and soil health opportunities in the agriculture sector.

# **Finances**

During a year that crippled many businesses and nonprofit organizations, Pecan Street's finances held strong, due in part to a diversification strategy our board adopted before the pandemic.

We sustained our foundation funding, including continued support from the Alfred P. Sloan Foundation, re-engaged with the Mitchell Foundation, and added new partners like the Energy Foundation.

Our sponsored research revenue includes a groundbreaking effort with the New York State Energy Research & Development Authority's (NYSERDA) Integrated Energy Data Resource (IEDR) effort. We also secured our first federal grant for our soil carbon work from the National Science Foundation.

Revenue from corporate and academic data licenses will continue to be an opportunity for future growth as we expand our research network to new regions and add new data collection capabilities.





Travel

\$6,714

#### FY 2020 - 2021 Revenue

**PECANSTREET.ORG** 

Equipment

\$19,812



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