“We have to investigate other materials that don’t use cement but form a product similar to concrete. We know what we need to do, and we have the capability here at ORNL to really make an impact immediately on the carbon emissions.”

—Building Envelope Research Group Materials Scientist Denise Antunes da Silva
Recent Impacts

**Building Envelope**
- Developed and demonstrated in a large-scale trial a new concrete mix that has 15% lower embodied energy, reduces by 40% the amount of concrete needed in precast insulated panels, and doubles the production capacity of precast plants without capital investment.
- Created an R&D 100 Award–winning novel autonomous self-healing sealant that self-repairs at ambient conditions and under water.
- Developed and demonstrated in a natural exposure test facility a novel thermally anisotropic building envelope system that diverts heat or cold away from the envelope storage in a thermal energy storage system for use on demand.
- Invented a high-performance concrete mix for precast wythes that received a US patent.

**Building Equipment**
- Collaborated with one of the nation's largest refrigeration unit suppliers to validate a refrigeration solution to address the ultracold last-mile distribution challenge for COVID-19 vaccines.
- Demonstrated an integrated cold-climate heat pump that reached the highest combined Energy Efficiency Ratio, heating a 50-gallon water tank within a half hour.
- Created an R&D 100 Award-winning ultraclean condensing gas furnace that utilizes monolithic acidic gas reduction to remove more than 99.9% of acidic gases and other emissions from furnaces.

**Sustainable Tools**
- Developed a digital tool that simulates the energy profile of every building in America to provide homeowners, utilities, and companies a quick method for determining energy use and cost-effective retrofits that can reduce energy and carbon emissions.
- Featured in the International Facility Management Association journal for recognizing 14 commercial buildings that meet the DOE Better Buildings Envelope Campaign goals.
- Developed computational fluid dynamics models of a typical supermarket to evaluate the potential for COVID-laden particle distribution in a variety of scenarios.
- Launched the Building Science Advisor, an online tool that helps building designers mitigate moisture risk in building envelopes.

**Demonstration Results**
- Instrumented a cross-laminated timber (CLT) hotel in South Carolina to study energy and peak demand reduction caused by the CLT's thermal mass and completed blower door testing, demonstrating that the structure greatly exceeded performance criteria for building airtightness.
- In collaboration with the University of Tennessee, Knoxville; the Knoxville Community Development Corporation; and industry partners, demonstrated a cost-effective, modular, exterior panel retrofit solution on 12 low-income single-family attached duplexes and on advanced HVAC equipment and controls in one small commercial site.
- Designed a carbon capture platform for incorporation into existing HVAC units on commercial and residential buildings.