The Savannah Housing Department is leading sustainable and affordable housing development in Georgia. It partnered with Southface Energy Institute, a member of the U.S. Department of Energy’s Partnership for Home Innovation Building America research team, to seek cost-effective solutions for increasing the energy efficiency of the Savannah Housing Department’s standard single-family home plans in the Savannah Gardens Community. Based on engineering, cost, and constructability analyses, the combined research team chose to pilot two technologies to evaluate efficiency and comfort impacts for homeowners: a heat-pump water heater in an encapsulated attic and an insulated exterior wall sheathing.

The team sought to determine the impacts of the heat-pump water heater on space conditioning in the home—in addition to real-world efficiency. The team upgraded the typical wall assembly from Huber Zip Sheathing to Zip-R Sheathing with a ½-inch layer of rigid foam insulation adhered to the oriented strand board (OSB). This assembly provides a thermal break around the entire structure, and it raises the clear-wall R-value by 24%.

Despite this increase, energy modeling predicted a mere 2% reduction in total energy consumption. The impacts of these two technologies were quantified by comparing measured data to a neighboring home built to the standard plan.

The test home was designed as a prototype for this community of more than 500 EarthCraft-certified single- and multifamily affordable homes and for other developers. The water heater and foam insulation were chosen because they required minimal additional trades training, and they had the potential to contribute significantly to reducing homeowner energy usage, which is especially important for income-constrained families.
Key Energy-Efficiency Measures

HVAC
- Ground-source heat pump
  18.6 energy efficiency ratio,
  3.7 coefficient of performance
- Well-sealed R-8 flex ducts and air
  handler in encapsulated attic;
  duct leakage to outside = 0 cfm at
  25 pascals
- Energy recovery ventilator spot-
  ventilation system
- Kitchen and bath fans vented to
  outside.

ENVELOPE
- R-20 open-cell spray polyurethane
  foam encapsulated attic
- Huber Zip System R sheathing (R-3.6
  continuous)
- R-13 grade-1 batt insulation in 2 × 4
  frame wall
- Double-pane low-e vinyl windows;
  U factor = 0.34, solar heat gain
  coefficient = 0.26
- Tightly sealed house; air changes
  per hour at 50 pascals = 1.9.

LIGHTING, APPLIANCES, AND
WATER HEATING
- 90% compact fluorescent lamps,
  10% linear fluorescent lamps
- ENERGY STAR® appliances
- Heat-pump water heater 2.33 energy
  factor.

Lessons Learned
Some of the many lessons learned are the following:

- Peak wall temperatures were reduced by a daily average of 3.4°F in the
  summer and increased by 6.4°F in the winter, and diurnal swings in tempera-
  ture were reduced.

- Exterior insulation reduced the time duration that wall-cavity temperatures
  were below dew point—and thus at risk for condensation.

- The test home with exterior insulation experienced reduced heating, ventilating, and
  air-conditioning (HVAC) run times and decreased total HVAC electricity
  consumption by up to 39%.

- The heat-pump water heater only impacts attic temperature and humidity while
  it is running; attic temperature and humidity return to previous levels shortly
  after the water heater stops running.

- The heat-pump water heater should not be used as a dehumidifier or as part
  of a fresh-air ventilation system because run times are intermittent and condi-
  tioning impact is slight.

- A heat-pump water heater is a cost-effective water heater—especially for
  all-electric homes.

- Different ducting configurations of heat-pump water heaters expand the
  variety of locations in which they can be installed without negatively impact-
  ing performance.