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Thoughts about the LEEP program
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My view is that details of LEEP should be left to GRU management. That of course doesn't stop me from writing up what I think I've learned:

LEEP should look into continuing some components of its current improvements, dropping others, and continue investigating others.

1. Continue
- repairing leaky ducts
- installing additional insulation
- weather stripping and caulking of doors and windows

2. Add
- insulating attics with no insulation (determine whether R-30 is cost effective)
- providing unlimited LEDs
- funding minor roof repairs
- repairing leaks in faucet valves
- repairing or replacing doors, glass, and windows
- repairing some structural damage, drywall

3. Drop
- replacing HVAC
- replacing room ACs with high-efficiency units
- replacing water heaters
- providing fluorescent light bulbs

5. Investigate
- programmable thermostats or programmable communicating thermostats, such as Nest
- electric panel upgrades

The items in the "continue" and "add" categories appear to be cost-effective, with good payback periods. Relatively small expenditures can have result in large reductions in air flow through a building's envelope.

The items in "drop" appear not to be cost effective. The energy savings from new appliances simply fall short relative to cost of those in the "continue" and "add" categories. Also the additions to residents' well-being are probably lower. As you can see from the forms provided by GRU, the cost of a new HVAC

unit can be $4,000 to $5,000 and of a water heater around $800. It appears that commensurate savings and comfort are seldom there, and the timing of replacements may be suboptimal.
Fluorescent light bulbs are good but LEDs appear to be cheaper in the long run and because of longer life, less dependent on user behavior. Electric panel upgrades seem like a good idea for the sake of safety.

I studied programmable thermostats at length. At first I was convinced that they are a great idea, especially by the following study:

Jonathan L. Bradshaw (Princeton and Stanford), Elie Bou-Zeid (Princeton), and Robert Harris (Princeton), all engineers, "Greenhouse gas mitigation benefits and cost-effectiveness of weatherization treatments for low-income American, urban housing stocks," Energy and Buildings, 128 (2016) 911-920.

This study reported: "Installing programmable thermostats is the most cost-effective treatment," with a two-year payback.

I am always skeptical of energy studies, especially when they require assumptions about human behavior. The authors allayed my skepticism by writing: "The method was evaluated in the previous study [16] by comparing the simulated savings to observations in Philadelphia. A good agreement was generally found although the model tends to overestimate the savings from combined treatment scenarios."

However, an FPL study, 2008-2009, based on 400 houses in South Florida, concluded that programmable thermostats resulted in 12% *more* energy usage. Many households simply did not use them. Some who did were more comfortable because they offset higher temperatures while out of the house with lower temperatures while at home. Despite the extra comfort, neither the energy saving nor the extra comfort was worth the cost.

Besides that, the EPA on May 4, 2009, stated "EPA has been unable to confirm any improvement in terms of the energy savings delivered by programmable thermostats and has no credible basis to extend the current ENERGY STAR specification."

FPL in 2014 was carrying out a new experiment with smart programmable thermostats able to communicate with cell phones, along the lines of Nest. I have not located a report on this study, but have requested a link from FPL's director of research.

As to Nest thermostats, a study by D. Parker, K. Sutherland, and D. Chasar of the Florida Solar Energy Center at UCF, written in 2016, found in a carefully done experiment that the payback period was four years. Nests were installed in homes with no instruction (beyond the Nest-provided written materials) or guidance about using them. As might be expected, the ROI was lowest with retirees and with concrete block houses (which retain heat). It was highest in wooden frame houses with all members working or going to school. The study was too small—only 22 houses—to serve for a confident decision, however.