Android Development of Beginners Project Applications

Step 1: Ideas for the Final Project

- Reducing my home carbon footprint

The Green House application describes five ways to reduce the carbon footprint of a home using relatively simple actions. This application is for anyone that would like to reduce the carbon footprint of a home. The steps described are based on my personal experience, and are effective at reducing energy consumption and thus lowering our home's carbon footprint. Reducing climate emissions from homes should help reduce or show the effects of climate changes. I created a broad list of topics to include as follows.

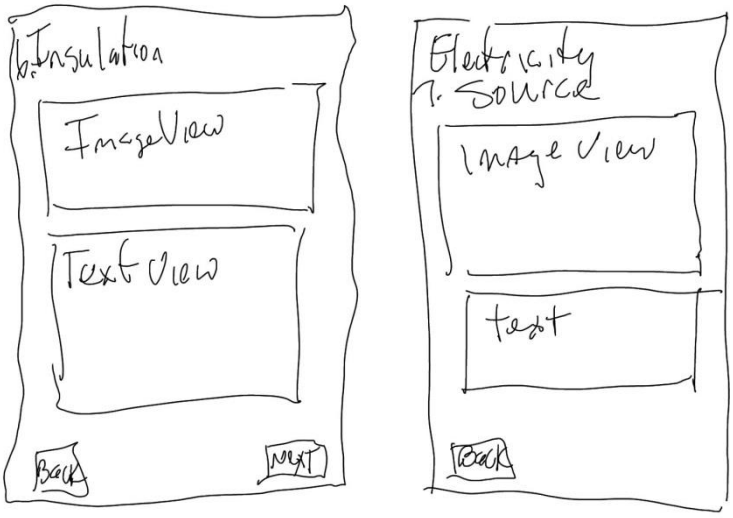
- Home heating
- Hot water
    - Short shower
    - Hot water heater
- Appliances
    - Dishwasher
    - Washing Machine
    - Dryer
    - Refrigerator
    - Home Electronics
    - Computers
    - Air Conditioners
    - Time of operation
    - Energy star when upgrading appliances & electronics
- Home Insulation
    - Airflow
    - Insulation
    - Fireplace
    - Energy Audit
    - Energy Credits
- Energy sources
    - Fuel energy density vs CO_2 emissions
    - Electric power distribution and generation
        - Select energy generation companies with higher renewable sources
    - Don't burn
- Energy Tracking
- Don't burn stuff

Step 2: Solution Design
The initial topic list was reduced to list of just five things that would reduce energy consumption in a home. The final topic out line and initial GUI sketches are shown below.

Final Topic outline

- Introduction
- Heating and Cooling
- Hot Water
- Appliances
- Insulation
- Electricity Generation Suppliers
- Summary

GUI Sketches



The GUI sketches were used to create an Android View outline which was used to generate each xml page in the app with minor modifications on the first page.

```
<ScrollView
        <RelativeLayout
                <LinearLayout
                        <TextView
                        <ImageView
                        <TextView
                </LinearLayout
                <RelativeLayout
                        <Button
                        <Button
                </RelativeLayout
        </RelativeLayout
</ScrollView
```

The initial app design was missing an if/else statement so the layout was modified to include a CheckBox that displays additional text when checked so that the app would meet all the specifications. The modified GUI outline is shown below.

```
<ScrollView
        <RelativeLayout
                <LinearLayout
                        <TextView (heading)
                        <ImageView (photo)
                        <TextView (Primary test)
                        <TextView (Notes)
                        <TextView (References)
                </LinearLayout
                <RelativeLayout
                        <Button (back button)
                        <Button (next button)
                </RelativeLayout
        </RelativeLayout
</ScrollView
```

Each topic was then researched and the text for each topic was written out as follows:

Topic Text for each TextView

1 Introduction

The release of Carbon Dioxide from human activity is having a profound effect on the climate by increasing the energy in the atmosphere. This additional energy results in extreme weather, like more intense storm; more frequent and intense tornados; stronger hurricanes and expanded hurricane seasons; and more severe droughts and flooding; loss of ice caps and glaziers; and rising sea levels. These changes in climate impact human activity and the Earth\'s ecosystem generally negatively. The Green House application describes five simple ways to reduce the carbon footprint of a home to help reduce the impact on the climate.

2 Heating and Cooling

Heating and cooling our homes consumes the majority of the total energy consumed in the home. Installing a programmable thermostat and setting it for lower temperatures at night will help reduce energy consumption by 10% according to Energy.gov.

During warm weather, Air Conditioning (AC) is the next major energy consumer. Upgrade AC to the most efficient system available when possible. Use the circuit breaker to deactivate the AC unit during non-seasonal use. Even newer AC units can consume significant power in standby.

Notes: Spacing heating accounts for 45% of home energy consumption and 6% to 25% for space cooling depending on location. Energy.gov estimates that programmable thermostats save 5% to 15% on your energy bill yearly. The energy savings from heating can be 1% per degree for setback periods of 8 hours or more. A 10 degree setback overnight would reduce energy consumption by 10% per year. When the thermostat is set back, the home loses energy more slowly. The longer the home is at a lower temperature the amount of energy lost is lower so more energy is saved. Natural gas is methane (CH4) and burning it produces 5.4 kg (11.7 lbs) of CO2 per therm. A therm is 100 cubic feet of natural gas and has the heat energy of 100,000 BTUs (29.3 kWh). CO2

emissions from electricity range for 0.006 lbs/kWh in Vermont to 2.07 lbs/kWh in North Dakota depending on the fuel sources used. The national average is 1.52 lbs/kWh.

References:
Energy.gov Thermostats
US EIA.gov CO2 Coefficients by fuel
EPA Greenhouse Gas Equivalencies Calculator
EPA Power Profiler
EPA GHG Equivalencies Calculator
EIA Residential Energy Consumption Survey

3 Hot Water

Heating hot water consumes 14% to 18% of the energy in the home after heating and cooling, so saving on hot water saves both water and energy. Then to lower hot water energy usage, measure the hot water temperature with a cooking thermometer and lower the hot water heater temperature to 130 degrees F. Install flow limiters on faucets and shower heads, and reduce shower time to reduce hot water usage.

Notes: Heating water accounts for 14% to 17% of the home energy consumption. 64 gallons of hot water are used daily on average in the USA. Most hot water heaters are set at 140 °F as the default setting. Every 10 °F reduction in temperature can reduce energy use by 3% to 5%. In most cases, setting the hot water heater to 120 °F is recommended, and 130 °F is used when required by the dishwasher or to kill off bacteria in the hot water heater. For a 85% efficient natural gas hot water heater, it takes 46,871 BTUs (13.7 kWh) to raise 64 gallons of water from 55 °F to 130 °F which generates 5.5 lbs of CO2 each day and 2002 lbs/year. This 10 °F temperature reduction reduces CO2 emissions by 267 lbs/year. This savings does not include the energy needed to hold the water at the lower set temperature.

References:
Energy.gov lowering water heating temperature
Energy.gov home water heating
Energy.gov Energy Savers 101 Everything you needed to know about Water Heaters

4 Appliances

Appliance consumes 35% to 43 % of the energy in the home. Set the washing machine to use the least amount of water possible and lowest temperature for a load of laundry. In warm climates or warmer season where the ground water temperature is warm enough to dissolve soap, use the cold/cold wash-rinse cycles. For the dryer, use the humidity sensors and the lowest heat setting possible to minimize drying time. Clean the lint tray in the dryer and exhaust pipe regularly. For the dishwasher, use the watermizer and no heat dry settings. Run appliances off peak.

Notes: Electrical appliances, electronics, and lighting consume up 35% to 43% of the home energy. Electricity consumption is measured in kilowatt hours (kWh). A 1000 W hair dryer running for an hour would consume 1 kWh, for example. A kWh produces between 0.6 lbs/CO2 to 2.07 lbs/kWh depending on location. Every kWh saved keeps

1.5 lbs of CO_2 from being emitted into the atmosphere on average. Generally, peak electricity demand occurs from 6 AM to 10 AM and 5 PM to 8 PM in the winter and between 4 PM and 8 PM in the summer. The cost of electricity can be 2 to 3 times more during peak demand time. Running appliances off-peak also helps reduces the need to employ low efficient energy generators to meet peak demand by the energy companies.

References:
EPA Carbon Footprint Calculator
EPA eGRID

5 Insulation

Insulating and sealing to stop air from recirculating between the attic and basement can reduce heat loss of a home significantly. Many types of insulation are available that include fiberglass, foam, and cellulose. A professional home energy audit will determine that best way to improve the energy efficiency of a home. Find a professional auditor at energystar.gov, and check your state for accredited auditors, incentives, and tax credits. State and Federal incentive programs may pay for a large part of the energy related improvement to a home.

Notes: Insulating and sealing a home reduces energy consumption by 5% to 20%. Insulation increases the R-value of the home which slows the heat flow in and out of the house. Heat and cooling loss can occur from air circulation from the attic to basement, or from air leaks. Sealing slows the loss of warm or cool air making the heating and cooling systems more efficient so less energy is consumed. A home energy audit identifies the optimum method to save energy and determines cost effective improvements. Many states have rebates and incentive programs that pay for a major portion of an energy audit and energy upgrades.

References:
Energy Star Methodology for Estimated Energy Savings from Cost-Effective Air Sealing and Insulating
Energy Star Why Seal and Insulate
Energy.gov Home Energy Audits
Energy.gov Energy Saver 101: Home Energy. Audits
Find a RESNET professional auditor
Energy.gov Energy Incentive Programs

6 Electricity Generation Suppliers

Electricity companies generate and distribute electricity. Many electricity companies have customer choice programs that let you select a third party electricity generation supplier. JCP&L, for example, provides a list of 83 electricity generation companies to choose from. Select an electricity generation supplier that uses the highest percentage of renewable energy sources to generate electricity. The lower cost electricity supplier will likely not have the cleanest electricity supply because oil, gas, and coal are heavily subsidized

Photo credit Topaz Solar Farm (550 MW) by NASA Jan 2, 2015.

Notes: Green power refers to electricity generated from renewable sources like solar, wind, geothermal, hydropower, biomass, ocean, and hydrogen. Retail electricity competition if available in your state allows you to purchase electricity from alternate suppliers many of which offer electricity generated from renewable sources. To cover the costs of acquiring renewable energy sources, there is a premium for small cost added that ranges from 0.09 cents/kWh to 11 cents/kWh. The residential cost of electricity ranges from 9.14 cents/kWh to 26.92 cents/kWh depending on location.

References:\n
EIA IS Energy Mapping System
Energy.gov Can I Buy Green Power in My State?
http://energy.gov/eere/femp/energy-incentive-programs
JCP&L Customer Choice
EIA Electric Power Monthly

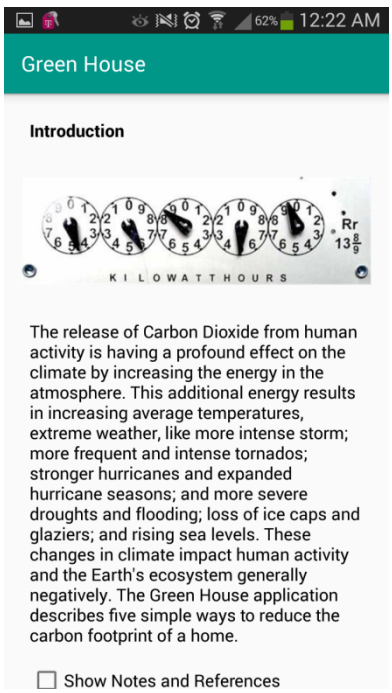
7 Summary

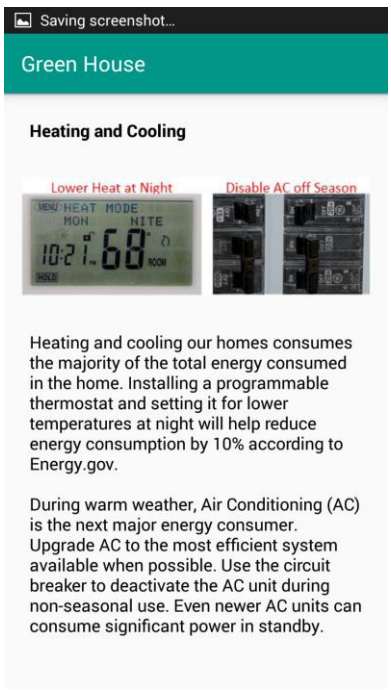
The five ways to reduce your home carbon footprint include:

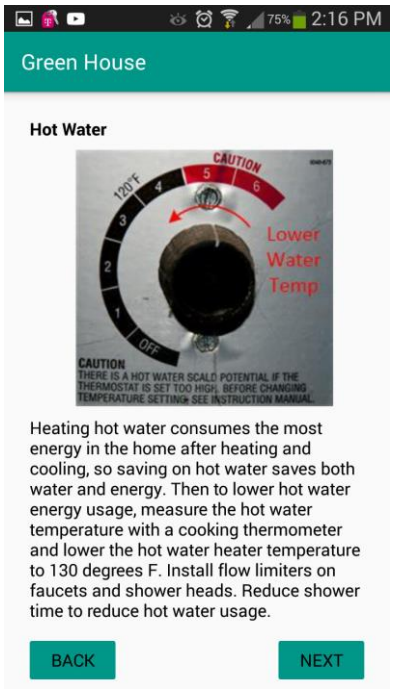
1. Install a programmable thermostat and deactivate air conditioning units out of season.
2. Lower the set temperature on your hot water heater, and use less hot water.
3. Operate appliances to use less hot water.
4. Have a professional home energy audit, and insulate as required.
5. Choose an electricity generation supplier that provides the most renewable energy sources.

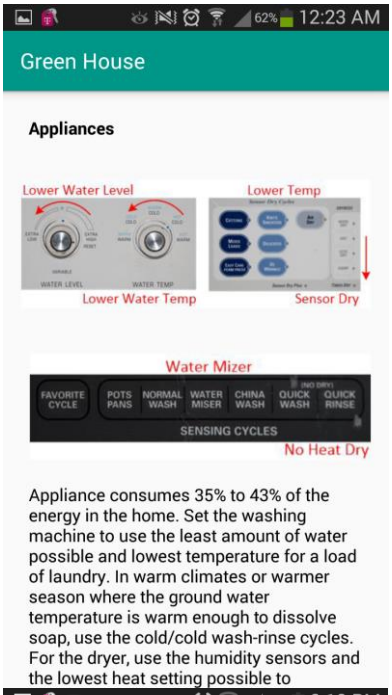
These five steps are only the beginning. Explore the reference links to learn more and work to become carbon neutral.

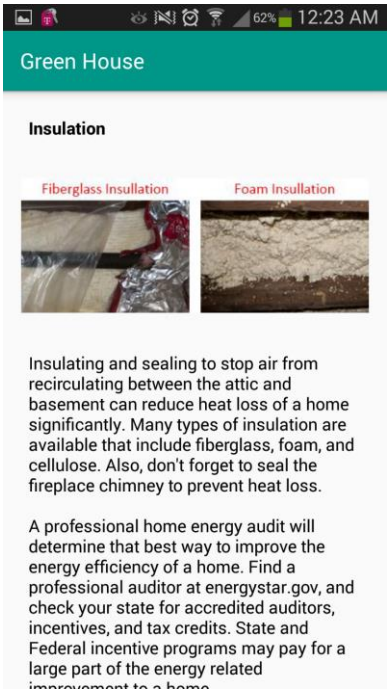
The app was coded and when through a lot of debugging. The final Screen Captures for each page are shown below.

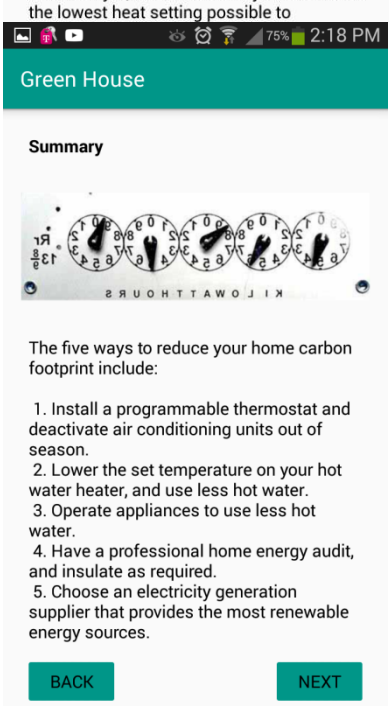












Step 3: Read the Project Rubric

The project rubric was review several times and sections of the app were modified to comply with all the specifications.

Step 4: Write Code to Make Your App

The android project directory, this document, and the read me files were all zip into GreenHouse.zip

Step 5: Write a README file

The GreenHouse app was written using Android Studio 1.5.1. The files were zipped into the GreenHouse.zip archive. Unzip the file in your android studio project directory so that the GreenHouse directory and the file below it sit in your project directory.

..\AndroidStudioProjects\GreenHouse
..\AndroidStudioProjects\GreenHouse\<app and all the other files and directories.>

Open the GreenHouse app as a project and rebuild the project if Gradle does not do it automatically (Build -> Rebuild project). Run the app on your phone or emulator. At the start onCreate starts with the activity_main.xml page. This is the first page of the app and gives an introduction to the problem of climate change. Check the CheckBox to see notes and references on the following pages.

Clicking the next page takes you to page 2. The main text of this page describes how to lower heating and cooling energy consumptions. If the checkbox was used on the first page, then notes and references are displayed. Clicking the links in the reference section will take you to websites outside of this app.

Clicking the back button takes you back to page 1 and clicking the next button takes you to page 3 which describe saving energy by reducing hot water consumption. Clicking the back button will take you to page 2. If the checkbox was used on the first page, then notes and references are displayed. Clicking the links in the reference section will take you to websites outside of this app.

Clicking the next button will take you to page 4 which describes how to reduce energy consumption by using appliances efficiently. Clicking the back button will take you to page 3. If the checkbox was used on the first page, then notes and references are displayed. Clicking the links in the reference section will take you to websites outside of this app.

Clicking the next button will take you to page 5 which describes how to reduce energy by insulation and sealing air leaks. Clicking the back button will take you to page 4. If the checkbox was used on the first page, then notes and references are displayed. Clicking the links in the reference section will take you to websites outside of this app.

Clicking the next button will take you to page 6 which describes how to low you carbon footprint by selecting an electricity supply that generates electricity from renewable energy sources. Clicking the back button will take you to page 5. If the checkbox was used on the first page, then notes and references are displayed. Clicking the links in the reference section will take you to websites outside of this app.

Clicking the next button will take you to page 7 which summarized the five things. Clicking the back button will take you to page 6. Clicking the next button will take you to page 1.

The methods associated with xml files are as follows:

onCreate -> activity_main, next button -> openPage2
openPage1 -> activity_main, next button -> openPage2
openPage2 -> s2_heating_cooling, back button -> openPage1, next button -> openPage3
openPage3 -> s3_hotwater, back button -> openPage2, next button -> openPage4

openPage4 -> s4_appliances, back button -> openPage3, next button -> openPage5
openPage5 -> s5_insulation, back button -> openPage4, next button -> openPage6
openPage6 -> s6_energy_sources, back button -> openPage5, next button -> openPage7
openPage7 -> s7_summary, back button -> openPage6, next button -> openPage1

Written by Jay Morreale for the Udacity 5 things final project for the Android Development for Beginners course submitted 4/17/16.
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