Tables of Contents:

Data Types:

Household:

Attribute	Data Type	Nullable
Email address	String	Not Null
Postal code	String	Not Null
Household type	String	Not Null
Square footage	int	Not Null
Thermostat heating	int	Null
Thermostat cooling	int	Null
Public utilities	List<String>	Null
State	String	Not Null
City	String	Not Null
Latitude	float	Not Null
Longitude	float	Not Null

Appliance:

Attribute	Data Type	Nullable
Appliance ID	String	Not Null
Appliance type	String	Not Null
Manufacturer	String	Not Null
Model Name	String	Not Null
BTU rating	Int	Not Null

Water heater:

Attribute	Data Type	Nullable
Energy Source	int	Not Null
Capacity	int	Not Null
Temperature	int	Null

Air handler:

Attribute	Data Type	Nullable
Heating	int	Not Null
Capacity	int	Not Null
Temperature	int	Null

Air conditioner:

Attribute	Data Type	Nullable
Energy efficiency ratio	float	Not Null

Table of Content

Heat pump:

Attribute	Data Type	Nullable
Heating seasonal performance factor	float	Not Null
Seasonal energy efficiency rating	float	Not Null

Heater:

Attribute	Data Type	Nullable
Energy source	string	Not Null

Power Generator:

Attribute	Data Type	Nullable
Power ID	int	Not Null
Generation type	String	Not Null
Avg. monthly kWph	int	Not Null
Battery storage capacity	int	Null

Business Logic Constraints:

- For household info
    - If user household email already exists, it should not be used to register another household
    - If postal code not matching the one in the database, should not be used to register household
- A household at least have one appliance listed to it
- If a household does not have any public utilities associated with it, then it is considered off-the-grid and must have at least one power generator associated with it.
- Postal code-Separate code for attribute
- Thermostat setting- No separate attribute

Task Decomposition with Abstract Code (AC):

Main menu

Task Decomposition:

No task involved for the main menu

Abstract code:
- Click on *Enter my household info* link – Jump to the **Household** task
- Click on *View reports/query data* link – Jump to **Reports** task

Household

Task Decomposition:
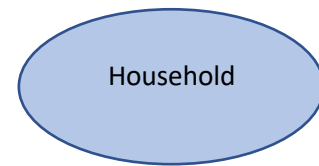**Lock Types**: Read and write locks on Household table
Number of Locks: 2
Enabling Conditions: None
Frequency: Medium frequency
Consistency (ACID): Not critical, order is not critical
Subtasks: No mother task needed. No decomposition needed.

Household

Abstract Code:

User enters email address ('$Email Address') and postal code ('$Postal Code') in the input fields
- If data validation is successful for both email address and postal code input fields, then:
  - User choose household type ('$Household type') and enters square footage ('$Square footage') value
  - Then user enters the thermostat setting for heating ('$Thermostat Heating') and cooling ('$Thermostat Cooling'), user will also have No heat and No cooling option to choose
  - If public utilities exist for a particular user:
    - User will select from Electric ('$Electric), gas('$Gas'), steam ('$Steam') and fuel ('$Fuel) oil options
  - Else:
    - Leave it unchecked
- Else:
  - When user email address is not matching with postal code entered in the database, go back to **Household** task, with the error message.
- Click the *Next button* to save the information in the database – Jump to **Appliance** task.

Appliance

Task Decomposition:

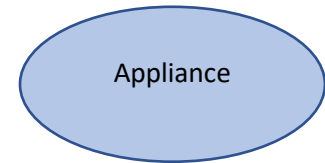**Lock Types:** Read and write locks on Appliance table
Number of Locks: 2
Enabling Conditions: None
Frequency: Medium
Consistency (ACID): Not critical, order is not critical
Subtasks: No mother task needed. No decomposition needed.

Abstract Code:

User should first enter add appliance form
- If appliance type entered is Air handler:
  - User will enter the manufacturer('$Manufacturer') and model's name ('$Model name')
  - Then User will have options to select from Air conditioner, Heater and Heat pump.
  - User enters energy efficiency ratio ('$Energy efficiency ratio') and the energy source ('$Energy source')
  - Once user add all the information it will Add more option
- Else (When appliance type is Water heater):
  - User will input the manufacturer('$Manufacturer') and model's name ('$Model name')
  - Then User will have options to select from Air conditioner, Heater and Heat pump.
  - User will input energy source ('$Energy Source'), capacity ('$Capacity'), BTU ('$BTU rating') and temperature ('$Temperature')
- Once data is entered, it will save to the database when saving from the screen.
- Click *Add* button - Jump to the **Appliance Listing** task

Appliances Listing:

Task Decomposition:

Lock Types: Read and write lookups for Appliance information
Number of Locks: 2
Enabling Conditions: None
Frequency: Medium
Consistency (ACID): not critical, order is not critical.
Subtasks: No mother task needed. No decomposition needed.

Abstract Code:

- User will see the list of each appliance's number ('$Appliance ID'), Appliance type ('$Appliance Type'), manufacture ('$Manufacturer') and model name('$Model')
- Then user will get three options on the screen
  - *Add another appliance* link
  - *Delete* link
  - *Next* button
- Click *Add another Appliance* link - Jump to **Add Appliance** task.
- If details are entered incorrectly:
  - Click **delete** link - To delete that particular appliance
- If all appliances are deleted, the user cannot leave **Appliance Listing** task until at least one appliance has been added
- Click *Next* - Jump to **Add Power generation** task.

Add Power Generation

Task Decomposition:

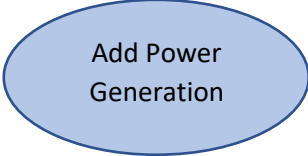**Lock Types:** Read and write lookup for Power generator info

Number of Locks: 2
Enabling Conditions: If household is off-grid, power generator info has to be entered
Frequency: Medium
Consistency (ACID): not critical, order is not critical.
Subtasks: No mother task needed. No decomposition needed

Add Power Generation

Abstract Code:

On **Add Power Generation** form
- If the household is off-the-grid:
  - Details like type ('$Type'), Monthly ('$Monthly kWh'), Storage ('$Storage kWh')(Optional detail) should be entered.
  - Click *Add* button - Jump to **Power Generation listing** task
- Else:
  - Click *Skip* button to finish submitting the form – Jump to **Wrapping up** page

Power Generation listing

Task Decomposition:

Power Generation listing

Lock Types: Read lookup for added power generator info and write look up for deleting power generator info
Number of Locks: 2
Enabling Conditions: None

Frequency: Medium
Consistency (ACID): not critical, order is not critical.
Subtasks: No mother task needed. No decomposition needed.

Abstract Code:
- All the added power generation methods will be displayed with details '$Power generator ID', '$Type', '$Monthly kWh', '$Battery kWh'
- Click *Delete* button to delete that particular added power generation method
  - If all the generators are deleted and household is off-the-grid:
    - At least one generator needs to be added.
- Click *Add more power* - Jump to **Add Power Generation** task
- Click *Finish* button - Jump to **Wrapping up** task

Wrapping up

Task Decomposition:

No task involved for the wrapping up page

Abstract Code:

- Thank you, message will be displayed
- Click *Return to the main menu* link - Jump to **Main Menu** task

Reports

Task Decomposition:

No task involved for the Reports page.

Abstract Code:

- User clicked on *View Reports/Query Data* link from **Main Menu**
- Upon:
  - Click *Top 25 Manufactures* button - Jump to **Top 25 Manufacturers** task
  - Click *Manufacturer/Model Search* button - Jump to **Manufacture/Model Search** task
  - Click *Heating/Cooling Method Details* button - Jump to **Heating/Cooling Method Details** task
  - Click *Water Heater Statistic by State* button - Jump to **Water Heater Statistic by State** task
  - Click *Off-the-grid Household Dashboard* button - Jump to **Off-the-grid Household Dashboard** task
  - Click *Household Averages by Radius* button - Jump to **Household Averages by Radius** task
- Click *Return to the main menu* link - Jump to **Main Menu** task

Top 25 Popular Manufacturers

Task Decomposition- Top 25 Manufacturers

Lock Types: Read-only on Appliance
Number of Locks: 1
Enabling Conditions: clicking on top 25 manufacturers report button from reports page
Frequency: Low
Consistency (ACID): not critical, order is not critical
Subtasks: no subtasks

Top 25
Manufactures

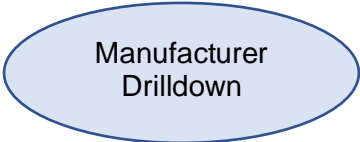### Task Decomposition- Manufacturer Drilldown

Lock Types: Read-only on Appliance
Number of Locks: 1
Enabling Conditions: Clicking on manufacturer
Frequency: Low
Consistency (ACID): not critical, order is not critical
Subtasks: no subtasks

Manufacturer
Drilldown

Abstract Code:

- User clicked on *Top 25 Manufacturers* from <u>View Reports/Query Data</u> page
- Run the *Top 25 Manufactures* task: query information for manufacturer name and raw count of appliances filtered to return 25 highest raw count of appliances and sorted in descending order.
  - o For each manufacturer returned, display Manufacturer, Total Appliance Count
  - o Each manufacturer in the table will be a button linking to the **Manufacturer Drilldown** task.
    - ▪ Click the *manufacturer's* button to run the **Manufacturer Drilldown** task: query types of appliances and count of each appliance type for the chosen manufacturer.
    - ▪ Display the drilldown table underneath the top 25 manufacturer table. Table will have rows for each appliance. Row will be Appliance, Appliance Count
- Click *Return to the reports* link - Jump to *reports* task

Manufacturer/Model Search

Task Decomposition:

Lock Types: Read-only on Appliance
Number of Locks: 1
Enabling Conditions: text entry and submit button click
Frequency: low
Consistency (ACID): not critical, order is not critical
Subtasks: no subtasks

Manufacturer/
Model Search

Abstract Code:

- User clicked on ***Manufacturer/Model Search*** from <u>View Reports/Query Data</u> page
- When a user enters a string into the textbox and clicks the ***Submit*** button, information from the text box Search('$Search') will be sent to the **Manufacturer/Model Search** task which will query for the model and/or manufacturer where the submitted text is a substring match and returns all entries of [Model, Manufacturer]. If the manufacturer matched then the query will return all pairs of manufacturers, models containing that manufacturer. If the model matched, the query will return the manufacturer and model details.
  - Entries will appear in a table. For each Manufacturer, add table entry Manufacturer, Model
  - If there's a search string match in either, highlight the search string
- Click ***Return to the reports*** link - Jump to ***reports*** task
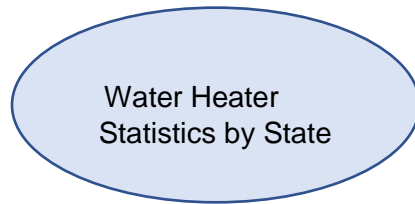
Heating/Cooling Method Details

Task Decomposition:

Heating/Cooling Report Query

Heating/Cooling
Method Details

Lock Types: Read-only on household, Heater, Heat Pump and Air conditioner
Number of Locks: 4
Enabling Conditions: clicking on heating/cooling method details button from reports page
Frequency: low- on user request
Consistency (ACID): not critical, order is not critical
Subtasks: no subtasks

Abstract Code:

- User clicked on ***Heating/Cooling Method Details*** from <u>View Reports/Query Data</u> page
- Run **Heating/Cooling Report Query** task: query for the following grouped by household type:
  - count of air conditioners, average air conditioner BTU, average EER,
  - count of heaters, average heater BTUs, most common energy source
  - count of heat pumps, average heat pump BTUs, average SEER, average HSPF
- Display air conditioner information grouped by household type:
  - For each household display: Air Conditioner, Avg Air Conditioner BTU, Avg EER
- Display heater information grouped by household type:
  - For each household display: Heater, Avg Heater BTU, Most Common Energy Source
- Display heat pump information grouped by household type:
  - For each household display: Heat Pump, Avg Heat Pump BTU, Avg SEER, Avg HSPF
  - Click ***Return to the reports*** link - Jump to ***reports*** task

Water Heater Statistics by State

Water Heater
Statistics by State

Task Decomposition:

Lock Types: Read-only on Household Info, Appliance Info, Water Heater, Air Handler
Number of Locks: 4, entities: appliances, household, water heater, air handler, multivalued attribute: public utilities
Enabling Condition: None, no prerequisite variable or entity required to generate reports.
Frequency: low- on user request
Consistency (ACID): Order is critical as drilldown report is based on state name contained in overall statistics.
Subtasks: Mother task not needed. No decomposition required.

Abstract Code:

Run the *Water Heater Statistics by State* task:

- Query the desired table and display the water heater details grouped by State name.
    - Display average water heater capacity.
    - Display the average water heater BTU.
    - Display average water heater temperature setting.
    - Display count of water heater where no temperature setting given.
    - Display count of water heater where temperature setting given.
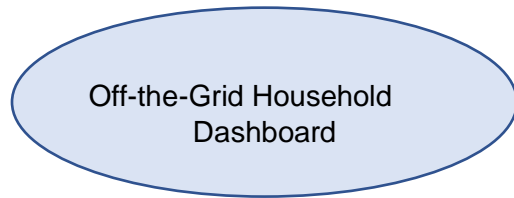- Each State in the table will be a button linking to *State Drilldown* task.

    Upon:

    - Click the State button – Jump to *Water heater statistics by selected State* task.
    - Query the database for given state-name ${State}, and get the result (as HTTP request, response).

    Display State as Table Header

    - Display min – max- average water heater capacity grouped by energy source.
    - Display min-max-average temperature setting grouped by energy source.
- Click *Return to the reports* link - Jump to *reports* task

Off-the-Grid Household Dashboard

Off-the-Grid Household
Dashboard

Task Decomposition:

Lock Types: Read-only on Household, Power generator, Water heater
Number of Locks: 3, entities: household, power generator, water heater
Enabling Condition: None, no prerequisite variable or entity required to generate reports.
Frequency: low- on user request
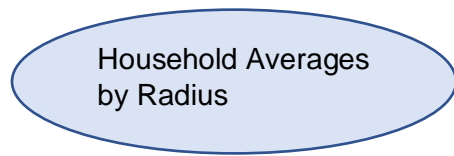**Consistency (ACID):** not critical. Since only one read operation is taking place.
Subtasks: Mother task not needed. No decomposition needed.

Abstract Code:

Run the *Off-Grid Household Dashboard* tasks:

- o Display state name along with count of most off-the-grid household.
- o Display average battery storage capacity for all off-grid households.
- o Display average water heater gallon capacity for all off-grid and on-grid households in parallel.
- o Display average battery storage capacity for all 0ff-grid households.
- o Display percentage of each power generation type (solar, wind etc).
- o Display min, max and average BTU for all off-grid households grouped by appliance type.

- ▪ Click *Return to the reports* link - Jump to *reports* task

Household Averages by Radius

Household Averages
by Radius

Task Decomposition:

Lock Types: Read-only on Household , Appliance, Power generator, water heater, air handler
Number of Locks: 5, entities: household, appliances, power generator, water heater, air handler
Enabling Condition: None, no prerequisite variable or entity required to generate reports.
Frequency: low- on user request
Consistency (ACID): not critical. Order is not critical.
Subtasks: Mother task not needed. No decomposition needed.

Abstract Code:

Run the *Household Averages by Radius Task*: query for information about the postal code ${postal-code} and radius (selected from drop down choices inbuilt) ${radius} using HTTP protocols.

If data validation is successful for Postal Code field, then:

- o   Display postal code.
- o   Display search radius.
- o   Display count of households in that radius.
- o   Display count of households for each household type.
- o   Average square footage.
- o   Average heating temperature
- o   Average cooling temperature
- o   Public utilities used [displayed in single cell separated by comma]
- o   Display count of off-grid home.
- o   Count of households with power generation.
- o   Most common generation method.
- o   Average monthly power generation.
- o   Count of household with battery storage.

- ▪   Click *Return to the reports* link - Jump to *reports* task

Else, postal code input invalid, display View Report page with Error message.
- ▪   Click *Return to the reports* link - Jump to *reports* task