1 Design Parameters

1.1 Microgrid Block Diagram

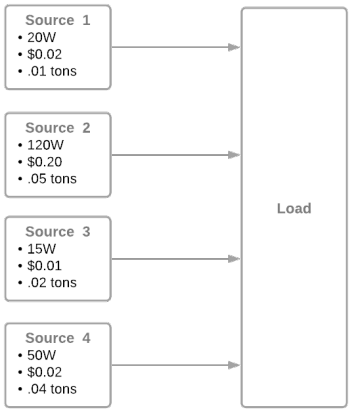

Figure 1: Block Diagram

1.2 Load Time Series

Here is a rough idea of what the load time series will look like. Due to its random generation it will change. slightly after each run.

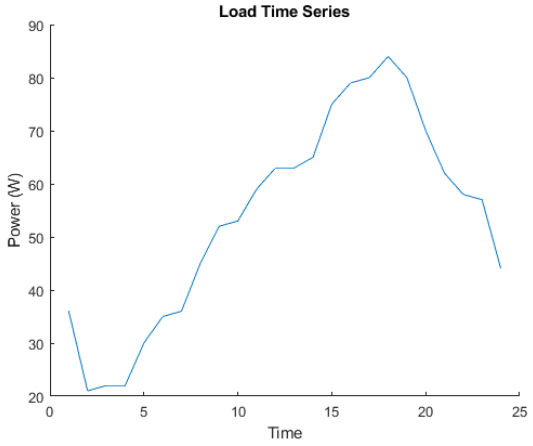

Figure 2: Load

1.3 Load Time Series Generation

This time series was designed by deciding with the idea that the power is being sent to a residential area. The usage would be low in the middle of the night and high when residents are home from work. It would gradually increase/decrease throughout the other parts of the day. The assumption is that a week days are being explored.

To find the values, a range was given for each hour through out the day. A value for each hour within these ranges is randomly selected. A set number of days can be produced. In order to smooth out the curve an additional parameter was utilized to combine a set of days into a group and take the mean. The purpose of this is to smooth out the curve into something that would look more realistic.

1.4 Source Chromosome Format

The chromosome format for each source is

$$[cost, emission]$$

1.5 Gene Boundaries

Each gene has a power boundary corresponding to its potential source output. The source can not output more than its limit.

- Source 1: [0, 20]
- Source 2: [0, 120]
- Source 3: [0, 15]
- Source 4: [0, 50]

1.6 Economic Optimization

Economic optimization means that lower cost is better. If the requirements can be met with lower cost this would be a beneficial economic adjustment.

Economic boundary for fitness function:

- $\$.15 \leq cost \leq \$6.55$
  - This range was chosen because the minimum is the least possible cost based on the power constraints and the max is the best possible cost plus a little extra due to the difficulty of finding the "best" solution in a GA.

1.7 Economic Fitness Boundaries

The economic fitness is ideally on a scale of 0 to 1, 0 being the most fit, but there will be some cases early on that goes off scale.

$$W * \frac{cost - min}{max - min}$$

1.8 Environmental Optimization

Environmental optimization would imply that less emissions produced would be better for the environment.

Environmental boundary for fitness function:

- $.15tons \leq emission \leq 3.75tons$
  - Again, the lower bound is the least possible emission and the upper bound is the best plus a little extra.

1.9 Environmental Fitness Boundaries

The environmental fitness is ideally on a scale of 0 to 1, 0 being the most fit, but there will be some cases early on that goes off scale. After the emissions for the chromosome was calculated equation that was used to determine the fitness is:

$$W * \frac{emssion - min}{max - min}$$

1.10 Boundary Function for Load

FIX

$$\begin{cases} 0 & x < 15 \\ 1 & 15 \leq x \leq 100 \\ 0 & x > 100 \end{cases}$$

1.11 Population Size

- Population size: 100

1.12 Mutation Rate

- Mutation rate: .1

1.13 Crossover Point

- Crossover point: 2

1.14 Stopping Condition

- Stopping point: fitness $\leq .08$

3 Design Implementation

3.1 chromosome_gen

3.2 mutation

3.3 mutate

3.4 crossover

3.5 econ_fitness

3.6 enviro_fitness

3.7 fitness

3.8

3.8.1 random_selection

3.8.2 elitism

3.9 stop_condition

3.10 store_best

3.11 power_plot

3.12 econ_plot

3.13 enviro_plot

3.14 calculation_plot

3.15 get_data

5 Analysis

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6 Recommendation

6.0.1 Improvements

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6.0.2 Concerns to Be Addressed