Group 5 – Carbon Emission Reduction Calculator C.E.R.C for Aggreko's Hybrid Solutions

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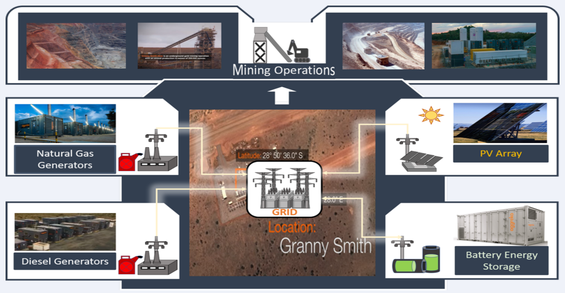
Background



- Aggreko is a global leader in providing reliable, and cost-effective rental power.
- Aggreko is keen in developing a tool to easily analyze its generational assets and how introducing hybrid solutions reduces carbon emissions

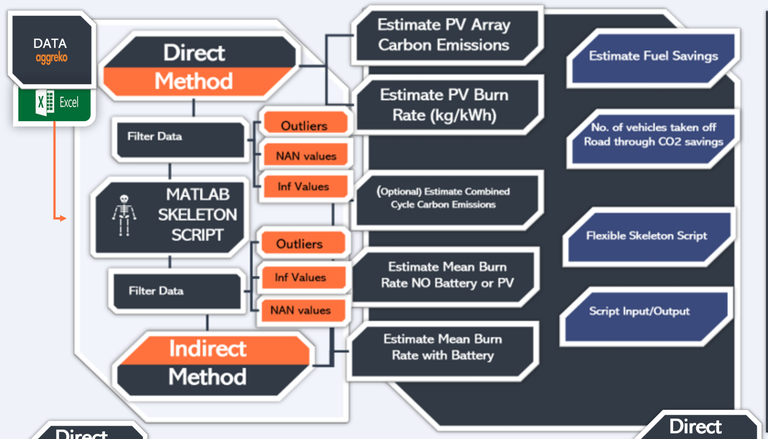
Problem Statement

- Meeting future requirements and policies under future carbon reduction initiatives.
- Quantifying Reliability, fuel cost, efficiency & environmental impact.
- Foundational cradle for data is necessary for future analysis.

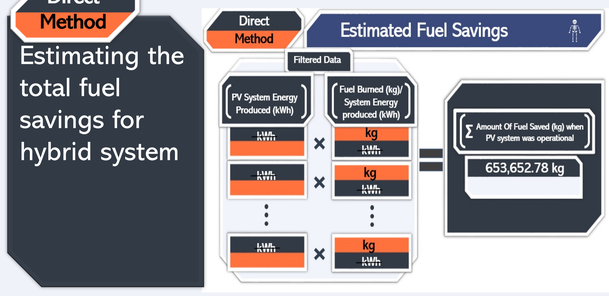
Objectives

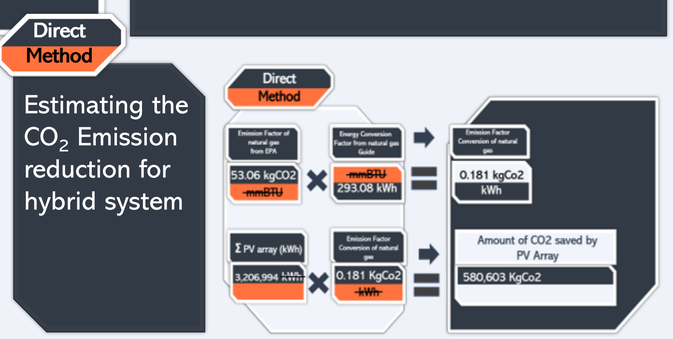
- Create & Design carbon reduction calculator, C.E.R.C
- Write script in MATLAB
- Skeleton script should…
  - Determine Fuel savings and approximate Carbon Dioxide emissions saved
  - Filter for data outliers and corrupt data
- Direct & Indirect Methods of measurement for further analysis.

MATLAB SKELETON SCRIPT C.E.R.C



- Read Raw Data into C.E.R.C.
- Filter & index
  - Outliers.
  - Non numerical values
  - Infinite values
  - Battery operational mode status
- Direct & indirect measurements.
- Estimate fuel savings.
- Estimate CO_2 emission reduction.
- Estimate no. of vehicles taken off road
- Estimate mean burn rate (kg/kWh).





Indirect Method — Difference in the Means Test Using z-Distribution

1 Mean burn rate comparison between thermal generator system VS hybrid combined system.

Burn Rate: amount of fuel consumed by thermal generators per unit of energy produced.

Stats from Thermal generators use only.
- Mean-0.214252258 kg/kWh
- Std dev.-0.093329582
- Variance-0.305498906

Stats from Combined Hybrid System.
- Mean-0.206921595 kg/kWh
- Std dev.-0.000428084
- Variance-0.020690187

$$\bar{x}_1 - \bar{x}_2 - z_{\alpha/2}\sqrt{\frac{\sigma_1^2}{n_1}+\frac{\sigma_2^2}{n_2}} \le \mu_1 - \mu_2 \le \bar{x}_1 - \bar{x}_2 + z_{\alpha/2}\sqrt{\frac{\sigma_1^2}{n_1}+\frac{\sigma_2^2}{n_2}}$$

2 Mean burn rate comparison between thermal generator system VS Battery storage system

Burn Rate: amount of fuel consumed by thermal generators per unit of energy produced.

Stats from Thermal generators use only.
- Mean-0.205456597 kg/kWh
- Std dev.-0.00085571
- Variance-0.029252527

Stats from Thermal generators and Battery storage.
- Mean-0.204270903 kg/kWh
- Std dev.-0.000203206
- Variance-0.01425502

Conclusions

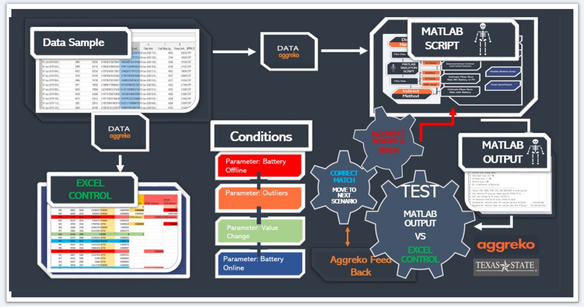
Direct Method
- PV Array implementation directly saved around 1,858,948 kgCO2 emitted per year. This is equivalent to taking 404 passenger cars off the road in a year.

Indirect Method 1
At a 90% confidence interval there was a difference between average fuel burn rates between only thermal generators being used vs. thermal generators coupled with the Y.Cube and PV Array.

Indirect Method 2
At a 90% confidence interval there was no difference between average fuel burn rates between only thermal generators being used vs. thermal generators coupled with the Y.Cube.

- Analysis of these two scenarios show that although the Y.Cube increased the reliability of the power grid, the PV Array is the main component in the grid that improved fuel efficiency and decreases CO2 output.

Testing Program



Future Opportunities

- Object orientated programming
- Optimization (O.R) capabilities.
- Include Upstream and downstream total carbon life cycles.
- Include net present worth analysis.
- Include statistical capabilities for all future measurements
- Include simulation models and GUI.

Team Members

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