REPORT ON FREEBORN INC.BEST LOCATION FOR ITS HEADQUARTERS IN AFRICA.

EXECUTIVE SUMMARY.

This report analyzes and compares key data points for four major cities in Africa - Kampala (Uganda), Nairobi (Kenya), Lagos (Nigeria) and Bujumbura (Burundi) - to help FreeBorn Inc. determine the best city to relocate their headquarters. The analysis includes two main components which are the emissions data for sulfur dioxide, particulate matter, nitrogen dioxide, carbon monoxide and ozone. Data for the emissions was provided thus was only cleaned and filtered, analyzed and visualized. This provides insight into the air quality and environmental condition of each city. The other data is cost of living data which was collected from Numbeo & Expatistan covering rental costs in the cities, utilities, health care. Education and groceries. The data was cleaned, filtered and visualized to compare the affordability of each location.
The combined data analysis shows that Lagos, Nigeria is the most favorable location based on the data. Nigeria has moderate emissions levels and a relatively low cost of living compared to other cities examined. Bujumbura and Nairobi also show a promise with lower emissions than the megacity of Kampala. The report provides FreeBorn Inc. with a data driven assessment to help inform their decision on the optimal city in Africa to establish their new headquarters. The detailed visualizations and comparisons give a clear picture of the environmental conditions and costs associated with their location.

DATA ANALYSIS AND FINAL VISUALIZATIONS.

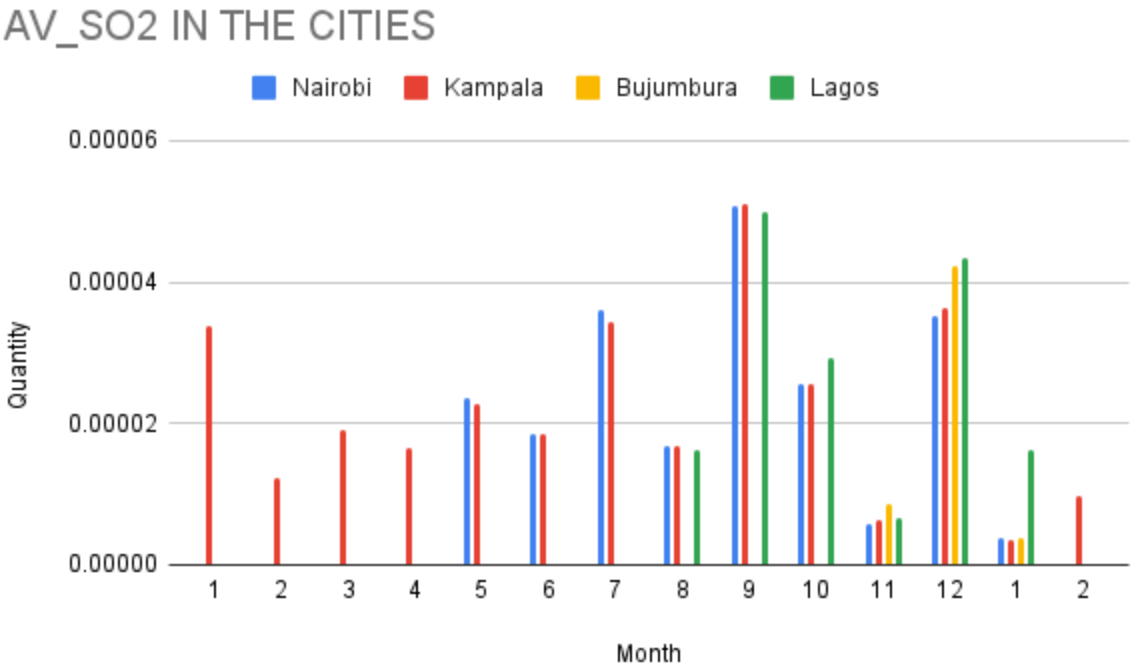
EMISSIONS DATA

Before performing analysis and visualization of the data, I downloaded the dataset (here.) and performed some data cleaning;

- Freezing and sorting - froze row one for ease column 1 reference, sorted column A by time (1000 to 1300 hrs,) sorted months from 1-12.
- Resizing columns for SO2, PM, NO2, CO2 & O3
- Handling missing data in the empty cells of columns for SO2, PM, NO2, CO2 & O3 with average values.
- Deleting unnecessary columns, site_id, site_latitude, site_longitude and date.
- Filtering for Kampala, Nairobi, Lagos & Bujumbura and aggregating monthly data for SO2, PM, NO2, CO2 & O3.
    - Find the data for Kampala, Uganda here. (K1:R15)
    - Find the data for Lagos, Nigeria here. (L1:S4715)
    - Find the data for Nairobi, Kenya here (K1:R1985)
    - Find the data for Bujumbura, Burundi here.(K1:R6556)

SULFUR DIOXIDE EMISSIONS

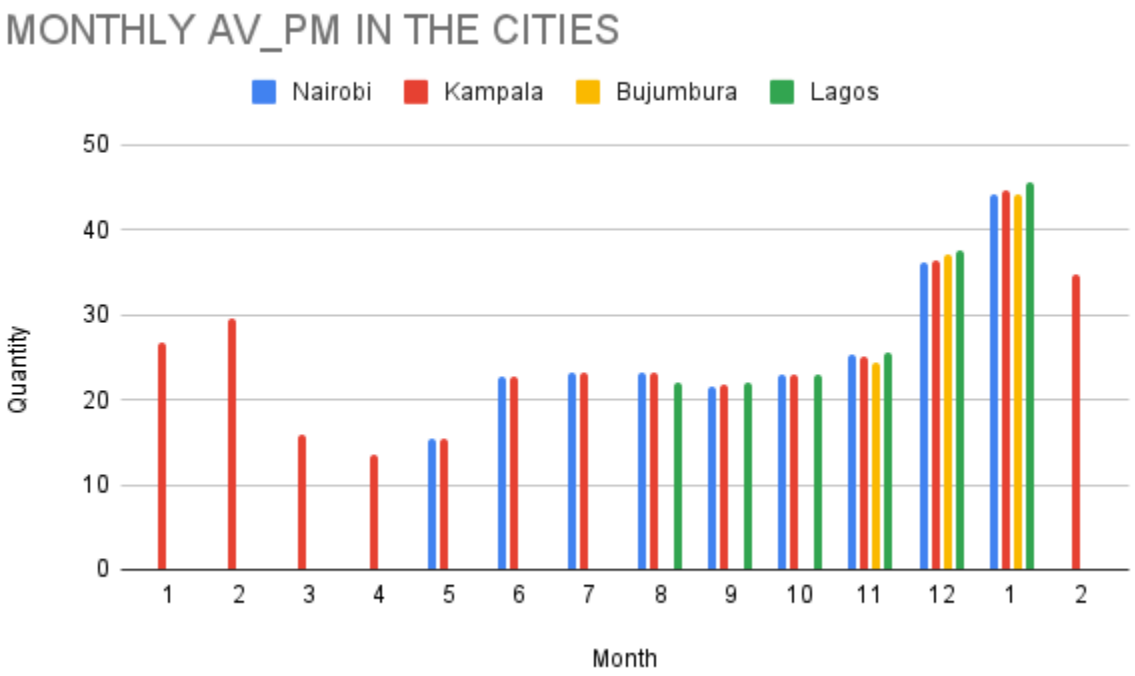
Kampala exhibits the highest emissions, Lagos follows with slightly lower emissions, Nairobi has moderate SO2 emissions while Bujumbura has the lowest emissions.
Find link here.



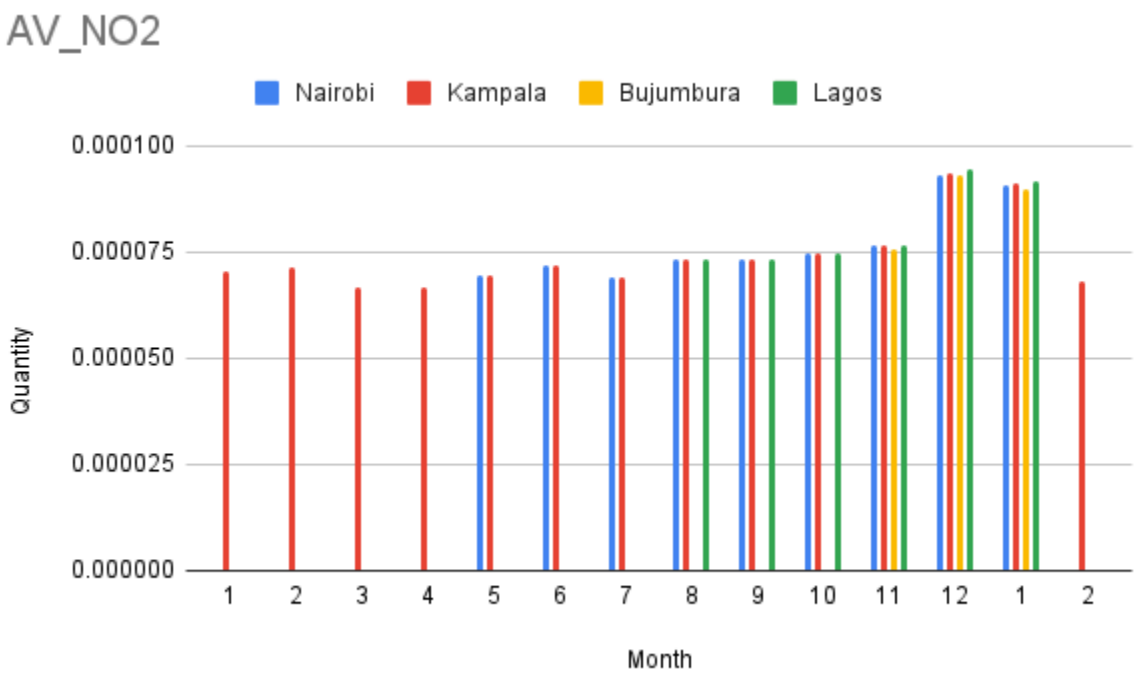
PARTICULATE MATTER.

Kampala exhibits highest PM emissions, Nairobi follows with slightly lower emissions, Lagos shows moderate PM emissions, and Bujumbura has the lowest emissions.

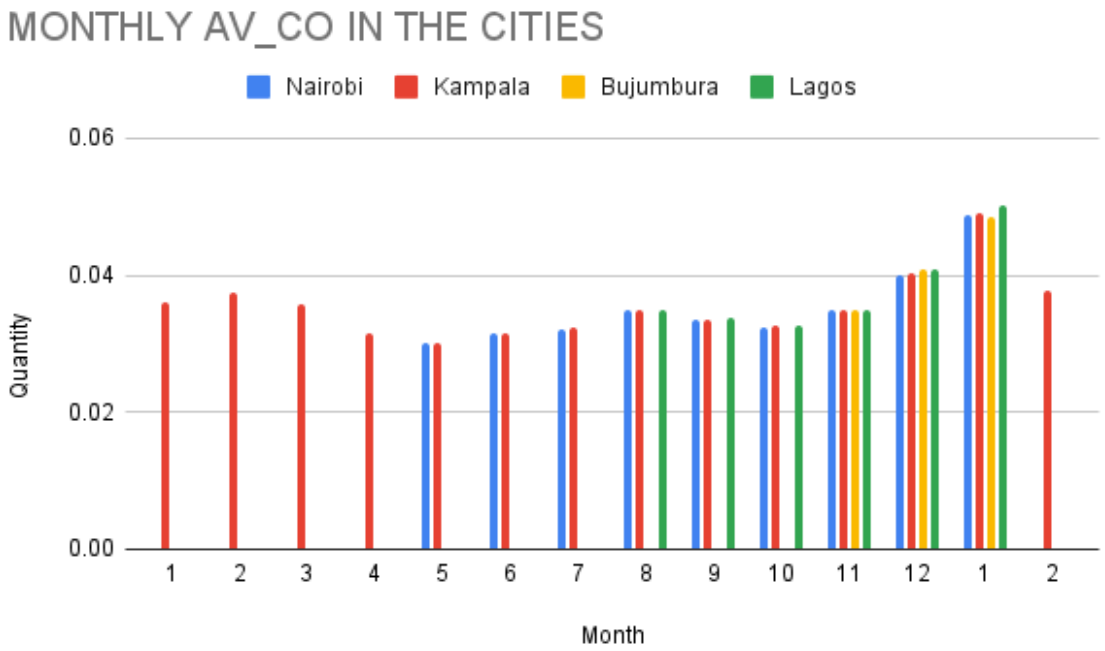
Find link here.



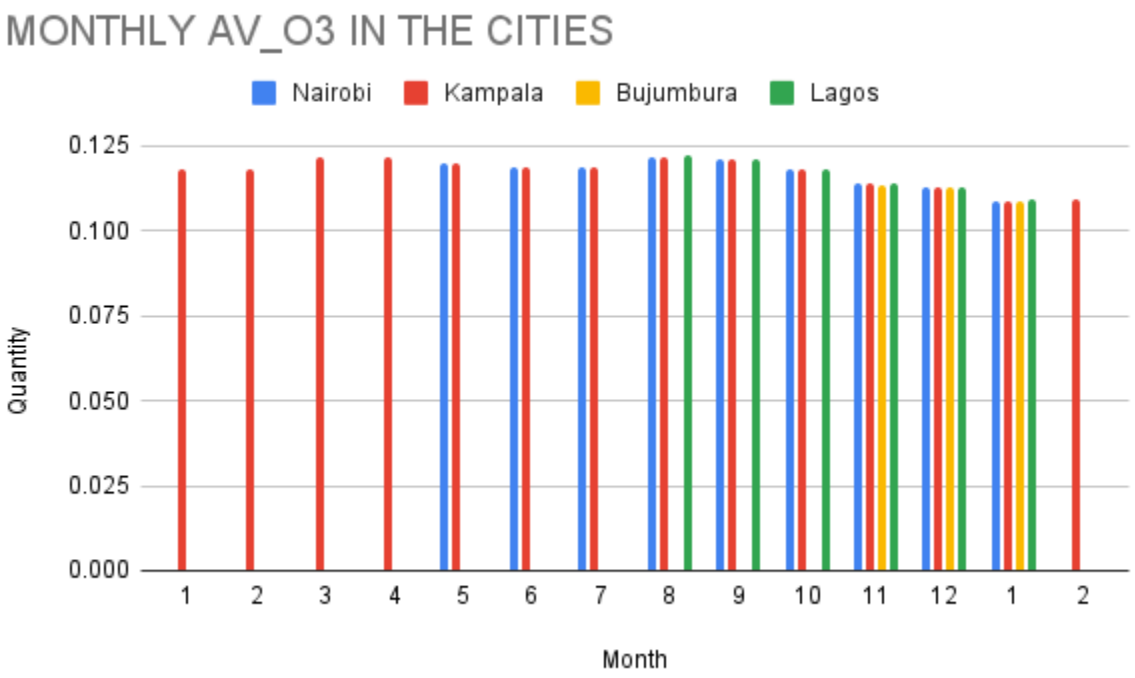
NITROGEN OXIDE.
Kampala exhibits highest NO2 emissions, Nairobi follows with slightly lower emissions, Lagos has moderate emissions while Bujumbura has the lowest emissions.
Find here.



CARBON MONOXIDE.
Kampala exhibits highest CO emissions, Nairobi follows with slightly lower emissions, Lagos has moderate emissions while Bujumbura has the lowest emissions.
Find link here.



OZONE.
Kampala exhibits highest O3 emissions, Nairobi follows with slightly lower emissions, Lagos has moderate emissions while Bujumbura has the lowest emissions.
Find link here.



PIVOT TABLE
Pivot table shows sum of emission per city in the year and it's clear;
SO2 - lowest in Bujumbura, followed by Lagos then Nairobi and highest in Kampala.
PM2.5 - lowest in Bujumbura, followed by Nairobi then Lagos and highest in Kampala.
NO2- Lowest in Bujumbura, followed by Lagos then Nairobi and highest in Kampala.
CO -Lowest in Bujumbura, followed by Lagos then Nairobi and highest in Kampala.
O3- Lowest in Bujumbura, followed by Lagos then Nairobi and highest in Kampala.

Find a link to the pivot table here.
The pivot table above is created in reference to the clean data in the link here.

D14

	A	B	C	D	E	F
1	*city*	SUM of sulphurdioxide_so2_colum	SUM of pm2_5	SUM of nitrogendioxide_no2_colum	SUM of carbonmonoxide_co_column_numb	SUM of ozone_o3_column_number_density
2		0	0	0	0	0
3	Bujumbura	0.004094257386	3775.947201	8.39E-03	4.629090176	13.70794706
4	Kampala	0.1339646175	127395.0884	3.89E-01	193.1449767	660.120387
5	Lagos	0.0236216938	39373.72626	8.93E-02	40.79969563	100.5842904
6	Nairobi	0.03242856395	28318.9948	1.08E-01	43.00108787	175.8568753
7	**Grand Total**	**0.1941091326**	**198863.7566**	**5.95E-01**	**281.5748503**	**950.2694998**
8						
9						
10						
11						
12						

The graphs indicate that Bujumbura has the lowest emission levels, followed by Lagos, Nairobi, and Kampala with the highest. Consequently, Bujumbura is the best choice for relocating the headquarters due to its superior air quality. The clean air in Bujumbura offers significant health benefits, including reduced respiratory diseases, improved mental health among employees, and healthier pregnancies and child development, making it an ideal location for relocation.

COST OF LIVING DATA.
DATA COLLECTION.

Collected data using Numbeo and Expartisan. Numbeo provided data for rent and utilities from 2016 to 2023 for all cities, though Bujumbura only had current averages. Expartisan supplied average data for groceries, healthcare, and education.

Data Cleaning:

- For Numbeo data, fill empty cells with median values (2016-2023).
- Calculated average rent and utilities for each city.
- Multiplied all values by 12 to show annual costs in USD

Find the links to the collected, pre-cleaned, and cleaned data here.

DATA ANALYSIS

Using advanced filtering and query functions, I separated data for each country. I added checkboxes next to cells for Kampala, Nairobi, Lagos, and Bujumbura. In cell C15, I used the "IFS" function to display the selected city when its checkbox is clicked. In cell G10, I used a query function linked to C15 to filter and display the respective city's data. For instance, clicking the checkbox for Lagos filtered and displayed all related data for Lagos.

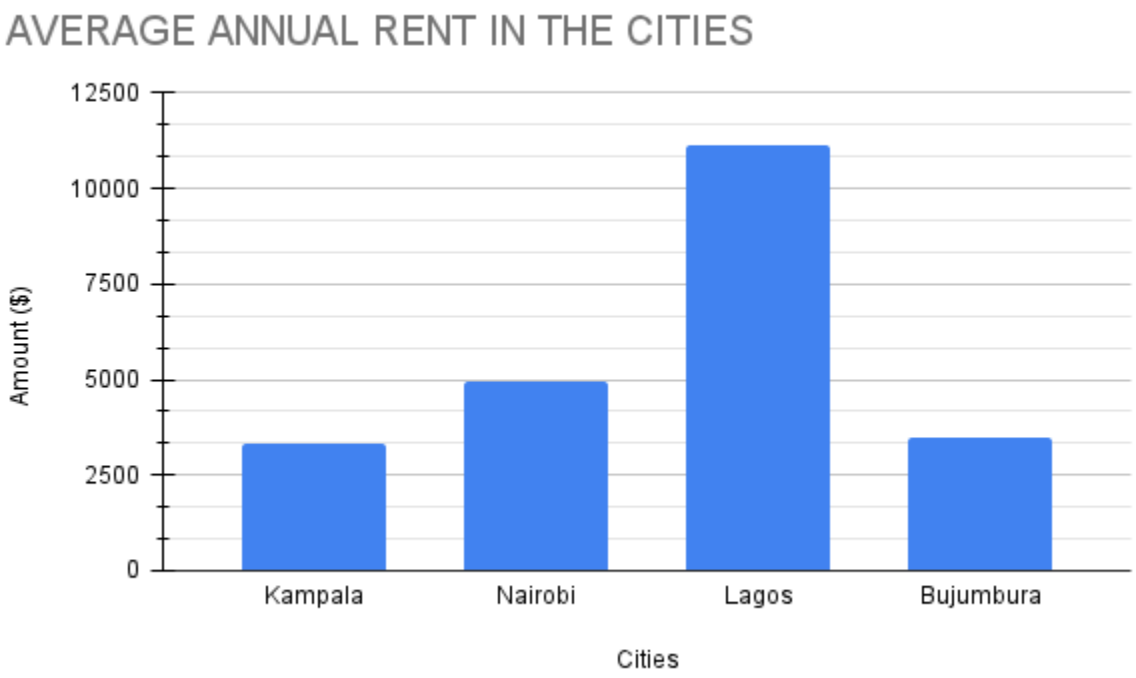
Please find the google sheet with the query function advanced filtration here

	A	B	C	D	E	F	G	H	I	J	K	L	M
1		AV_RENT	AV_UTILITIES			AV_School Fees		AV_Health care			AV_Gloceries		
2			Basic ($)	Internet ($)	Phone ($)	Pre-school ($)	Int. Pri-school ($)	Cold medicine ($)	Anti biotics ($)	Outpatient ($)	Milk ($)	Bread ($)	Lunch ($
3	pala	3299.91	618.855	954.105	160.8	1847.4	57613.8	42	72	192	9.48	9.72	
4	obi	4973.655	538.995	659.07	165	1744.68	90714.96	41.16	120	144	11.28	5.4	
5	os	11140.875	494.145	652.125	122.28	1421.16	24277.68	16.2	28.8	132	12.12	6.24	
6	mbura	3487.2	550.6656	755.1	149.3604	1236.72	123674.64	120	120	144	12	17.04	
7													
8													
9													
10			☐	Kampala				AV_RENT	AV_UTILITIES E	Internet ($)	Phone ($)	AV_School Fees	Int. Pri-
11			☐	Nairobi			Lagos	11140.875	494.145	652.125	122.28	1421.16	2
12			☑	Lagos									
13			☐	Bujumbura									
14													
15			Lagos										
16													
17													
18													
19													
20													

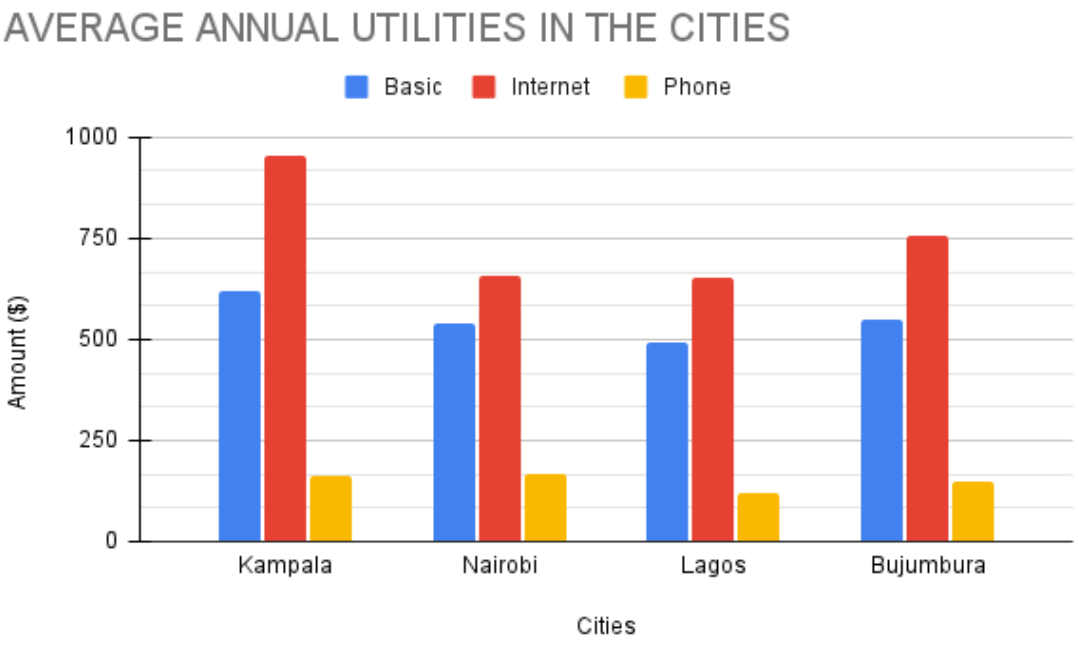
DATA VISUALIZATION.

RENT

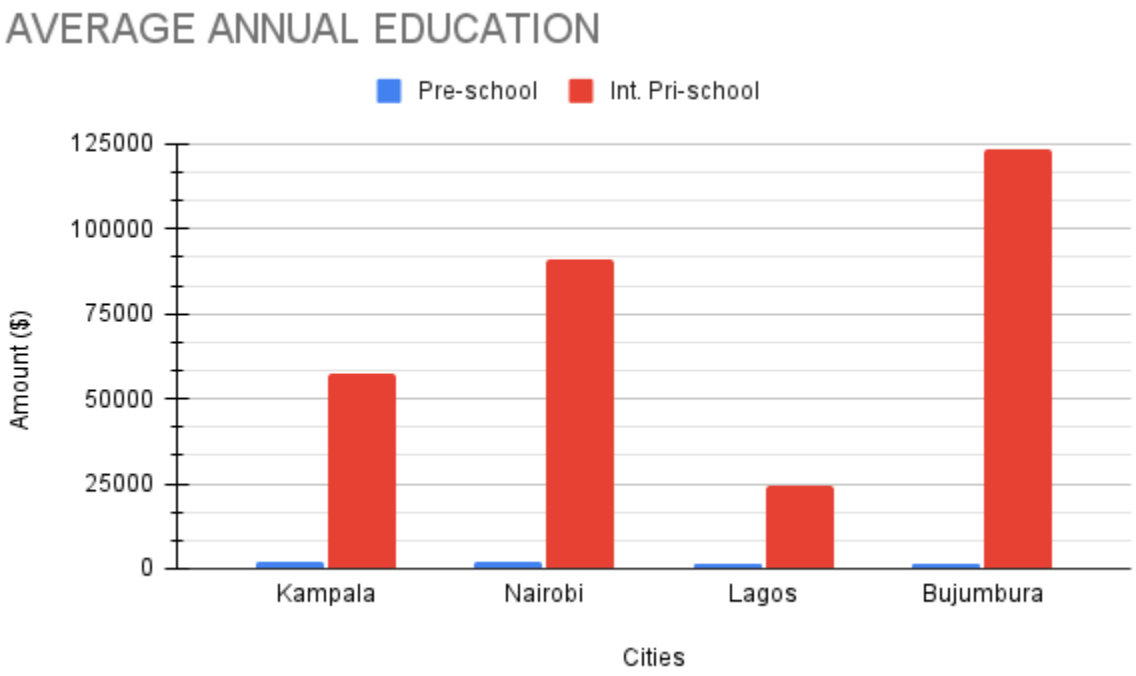
The average annual rent in dollars shows that Kampala is the most affordable city, followed closely by Bujumbura. Nairobi is more expensive, and Lagos is the most expensive city to live in (Lagos > Nairobi > Bujumbura > Kampala).



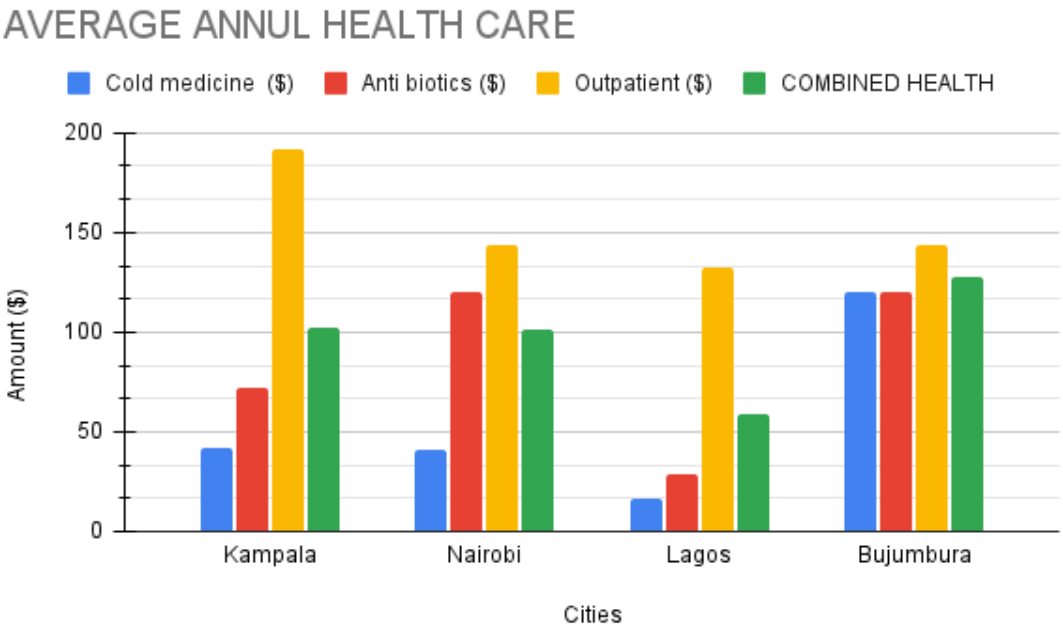
UTILITIES.
In terms of basic utilities, phone, and internet costs, Lagos is generally the most affordable city, while Kampala is the most expensive. Nairobi offers affordable basic and internet utilities compared to Bujumbura, but phone utility is more affordable in Bujumbura than in Nairobi. So the ranking from most to least expensive would be: Kampala > Bujumbura > Nairobi > Lagos.



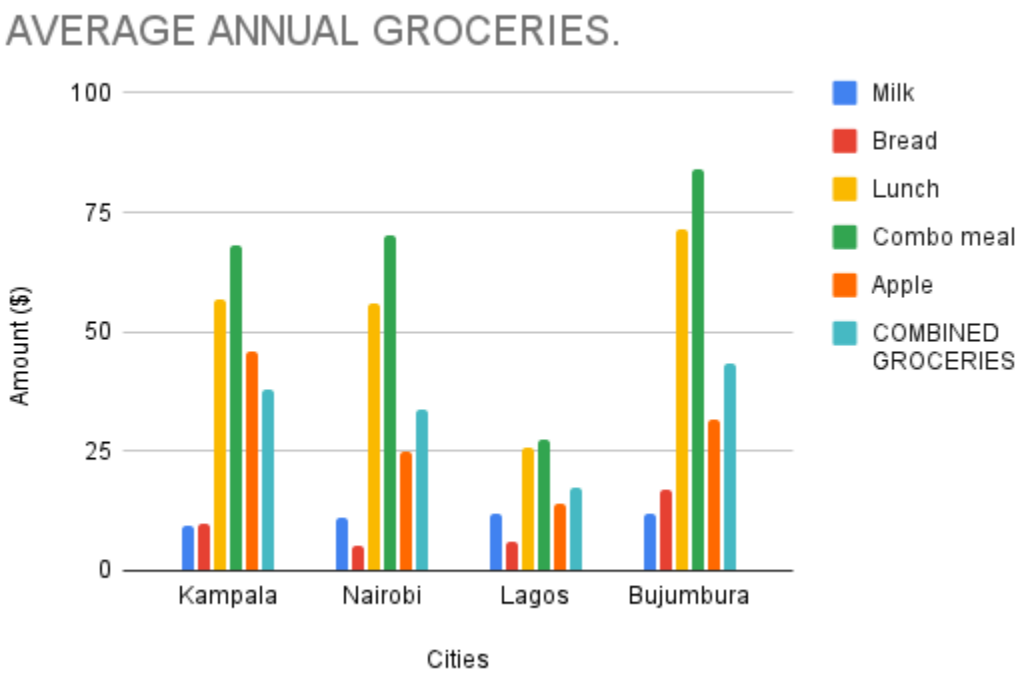
EDUCATION.
Bujumbura offers the most affordable pre-education, followed by Lagos, Nairobi, and Kampala. However, for primary school education, the ranking is reversed: Bujumbura has the most expensive, followed by Nairobi, Kampala, and Lagos, which offers the most affordable primary school education.



HEALTH CARE.
Lagos offers the most affordable rates for cold medicine, antibiotics, and outpatient treatment combined, followed by Nairobi, then Kampala, and finally Bujumbura, which has the most expensive health rates.



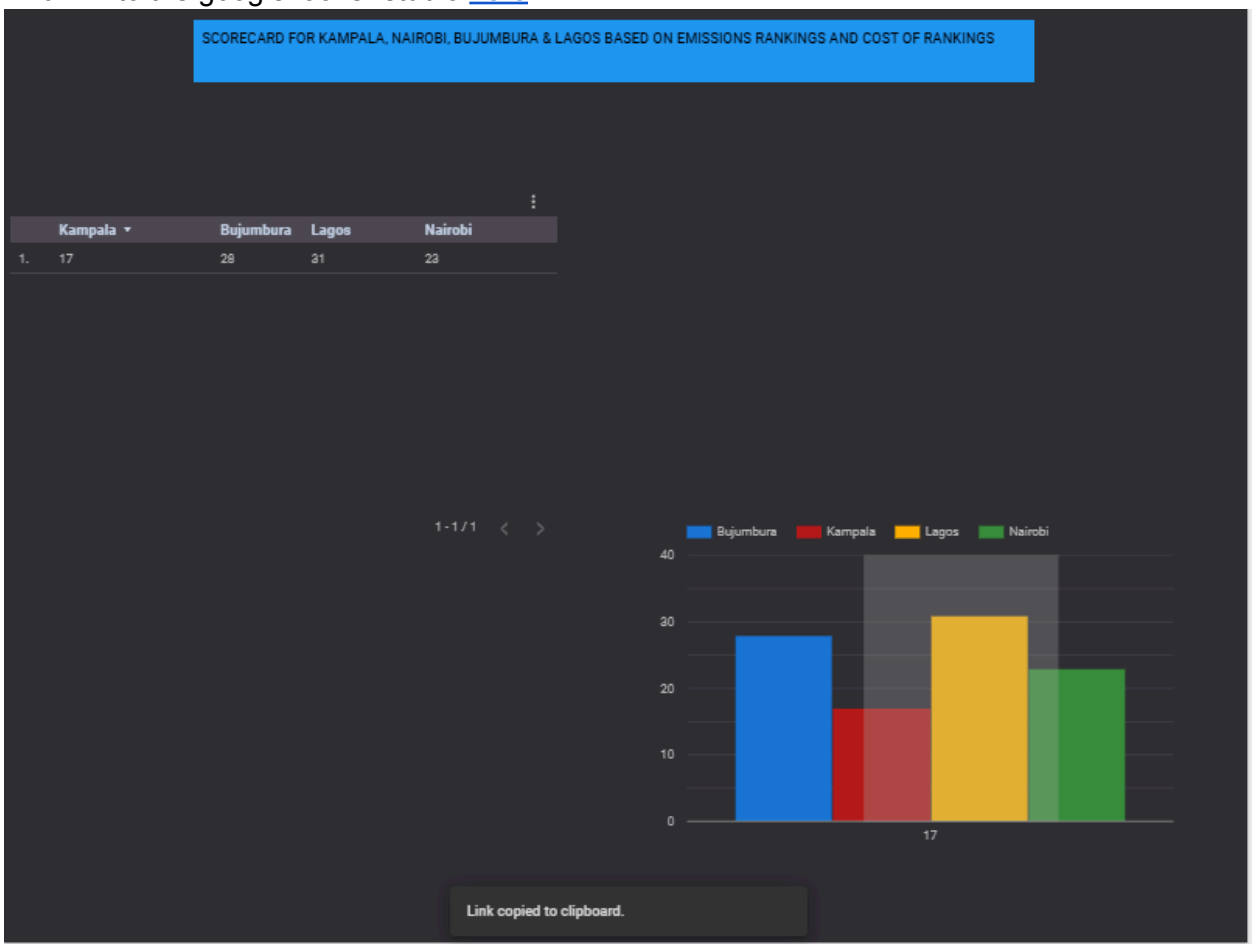
GROCERIES.
In terms of combined groceries Bujumbura has the highest rates, followed by Kampala, then Nairobi and lastly Lagos with the most affordable rates.
(Bujumbura>>Kampala>>Nairobi>>Lagos)



GOOGLE LOOKER STUDIO.
Creating interactive charts
I was able to create interactive charts for emissions experienced in the 4 cities and I was able to make observations of the trend of each emission for each country on a monthly basis or on per emission basis. For each emission, I was able to create a table, a bar graph and a line graph to gain better insights of the condition in each city.
For the cost of living in the 4 cities, I was able to add interactive charts of google maps, a table and a bar graph displaying the various trends in the cities.
Find the link to the looker studio board here.

To make a conclusion of the city that has the highest probability of having lowest average emission and affordable cost of living with a balance stroke between the two, for each indicator I assigned marks to each country based on its position.
For each emission, the country with lowest emission, received 4 points while the city with highest received 1 point, whilst the other 2 received 2 and 3 points with respect to their emission amounts.
For the cost of living, I also assigned points that ranged from 1-4.
Country with lowest cost of living was awarded 4 points while the city with highest cost of living was awarded a point with the other 2 cities receiving 2 and 3 points with respect to their cost of living.
From this analysis, I made the sum for each country and the country with the highest score was the most favorable city for the relocation of the headquarters.

Lagos scored highest while Kampala scored lowest with Bujumbura taking the 2nd position and Nairobi taking the 3rd position and the data was presented in the form of a table and a graph on google looker studio board.
Find link to the google looker studio here



RECOMMENDATIONS

Based on the comprehensive analysis of emissions data and cost of living metrics for Kampala, Nairobi, Lagos, and Bujumbura, it is recommended that FreeBorn Inc. relocate their headquarters to Lagos, Nigeria. This recommendation is driven by the following key findings:

1. Moderate Emissions Levels: Lagos exhibits moderate levels of sulfur dioxide, particulate matter, nitrogen dioxide, carbon monoxide, and ozone, which indicates relatively better air quality compared to some other major cities analyzed.

2. Lower Cost of Living: The cost of living in Lagos, including expenses for rent, utilities, healthcare, education, and groceries, is comparatively lower. This financial advantage will contribute to reduced operational costs for FreeBorn Inc., enhancing their economic efficiency.

3. Balanced Environment and Affordability: Lagos strikes a favorable balance between maintaining moderate environmental conditions and providing a cost-effective living environment. This balance is crucial for ensuring the well-being of the employees and sustainability of the business operations.

Although Bujumbura and Nairobi also present themselves as viable options with their lower emissions, Lagos stands out due to its combination of environmental and economic benefits. Consequently, establishing the headquarters in Lagos will position FreeBorn Inc. for both immediate and long-term success.

CONCLUSION.

This report has provided a detailed comparison of key environmental and economic factors for Kampala, Nairobi, Lagos, and Bujumbura. By analyzing emissions data for critical pollutants and evaluating cost of living metrics, we have identified Lagos, Nigeria as the most favorable city for relocating FreeBorn Inc.'s headquarters. The moderate emission levels and lower cost of living in Lagos make it an optimal choice, promising a sustainable and economically viable environment for the company's operations.

The visualizations and data-driven insights presented in this report offer a clear perspective on the various aspects influencing the decision. As FreeBorn Inc. moves forward with its relocation plans, Lagos emerges as the best strategic choice, combining environmental sustainability with economic practicality. This relocation will not only support the company's growth and profitability but also ensure a better quality of life for its employees.