“**Smart Home Energy Usage Insights: BigQuery & Power BI Driven Analysis**”

From Raw Data to Actionable Energy Efficiency Insights

Role: Data Analyst
Date: 2025-09-15

Business problem: “Energy consumption optimization is critical”

Key findings:

- Weekends have **3% higher avg consumption** than weekdays
- Peak usage occurs **between 6–8 PM**
- Weather (temperature) strongly impacts consumption patterns

Tools used: **Python, BigQuery, Power BI**

Deliverables: **Dashboard + Insights + Forecast**

- Background of dataset (**University of California, Irvine** Appliances Energy Dataset)
- Objective of the project:
- Identify peak demand periods
- Compare weekend vs weekday usage
- Correlate weather with consumption
- Build dashboards for storytelling
- Provide recommendations

•Dataset description:
•**19735 records** (Jan–May 2016)
•Columns: Appliances, Lights, T_out, RH_out, Windspeed, etc.
•Data sources:
•Raw CSV (UCI ML Repo)
•Stored in **BigQuery**
•Analyzed in **Python + SQL**

Schema | Details | Preview | Table Explorer | Preview | Insights | Lineage | Data Profile | Data Quality

Row	date	Appliances	lights	T1	RH_1	T2	RH_2	T3	RH_3	T4	RH_4	T5
1	2016-01-11 17:00:00 UTC	55.0	35.0	19.89	46.5027777...	19.2	44.6265277...	19.79	44.8977777...	18.93277777...	45.73875	17.166666
2	2016-01-11 18:00:00 UTC	176.6666666...	51.66666666...	19.89777777...	45.8790277...	19.26888888...	44.4388888...	19.77	44.8633333...	18.90833333...	46.0666666...	17.111111
3	2016-01-11 19:00:00 UTC	173.3333333...	25.0	20.49555555...	52.80555555...	19.92555555...	46.0616666...	20.05222222...	47.2273611...	18.96944444...	47.8155555...	17.136111
4	2016-01-11 20:00:00 UTC	125.0	35.0	20.96111111...	48.4533333...	20.25111111...	45.6326388...	20.21388888...	47.2688888...	19.19083333...	49.2279166...	17.615555
5	2016-01-11 21:00:00 UTC	103.3333333...	23.33333333...	21.31166666...	45.7683333...	20.58777777...	44.9611111...	20.37333333...	46.1644444...	19.42555555...	47.9188888...	18.427222
6	2016-01-11 22:00:00 UTC	266.6666666...	21.66666666...	21.57222222...	44.6633333...	20.90555555...	44.1188888...	20.46944444...	45.8294444...	20.10888888...	47.5066666...	19.112916
7	2016-01-11 23:00:00 UTC	56.66666666...	18.33333333...	21.53166666...	44.2711111...	20.93444444...	43.7125	20.31791666...	45.6958333...	20.90972222...	46.55125	19
8	2016-01-12 00:00:00 UTC	141.6666666...	16.66666666...	21.26611111...	44.9605555...	20.63722222...	44.0183333...	20.14444444...	45.5422222...	20.51444444...	47.1127777...	19.155555
9	2016-01-12 01:00:00 UTC	168.3333333...	8.333333333...	20.96361111...	45.6131944...	20.33333333...	44.2733333...	20.13333333...	45.54	21.50555555...	46.9466666...	18.969444
10	2016-01-12 02:00:00 UTC	45.0	0.0	20.69666666...	46.1977777...	20.06666666...	44.5033333...	20.17083333...	45.4541666...	21.14305555...	45.9055555...	18.813333
11	2016-01-12 03:00:00 UTC	35.0	0.0	20.46222222...	46.24	19.79222222...	44.56	20.23	45.4277777...	20.41666666...	46.1088888...	18.655555
12	2016-01-12 04:00:00 UTC	45.0	0.0	20.22944444...	46.4836111...	19.59999999...	44.6511111...	20.285	45.525	19.95111111...	46.3966666...	18.522222
13	2016-01-12 05:00:00 UTC	43.3333333...	0.0	20.03888888...	46.3388888...	19.41444444...	44.77	20.32333333...	45.59	19.65444444...	46.6388888...	18.422083
14	2016-01-12 06:00:00 UTC	40.0	3.333333333...	19.89611111...	46.5133333...	19.263	45.0661111...	20.30111111...	45.5488888...	19.41611111...	46.715	18.317777
15	2016-01-12 07:00:00 UTC	56.66666666...	18.33333333...	19.80666666...	47.2119444...	19.16249999...	45.2191666...	20.14444444...	45.29	19.24944444...	46.4216666...	18.218333
16	2016-01-12 08:00:00 UTC	86.66666666...	10.0	19.85666666...	48.5988888...	19.05370370...	45.0868518...	20.13055555...	45.2375000...	19.14444444...	45.5961111...	18.047222

Methodology:

Break into pipeline style:

1.Data Collection

1. Imported CSV → BigQuery
2. SQL queries for aggregation (hourly/day/week level)

2.Data Preparation (Python)

1. Converted timestamps
2. Resampled into hourly means
3. Created features (hour, day, month)
4. Calculated total_consumption

3.Exploratory Analysis

1. Trend charts
2. Weather correlation
3. Weekend vs Weekday usage

4.Visualization (Power BI)

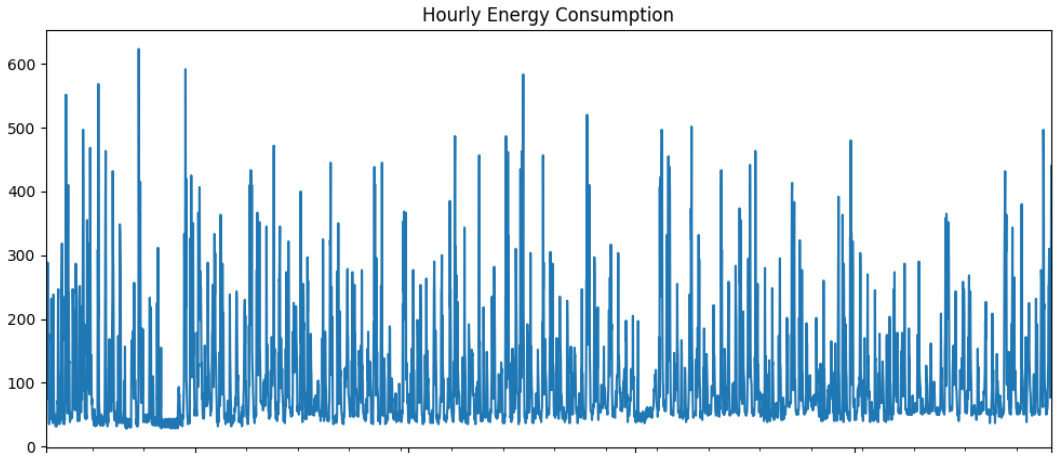
1. Daily consumption trend
2. Weather vs Usage scatter
3. Top 10 peak days
4. KPI cards (min, avg, peak)

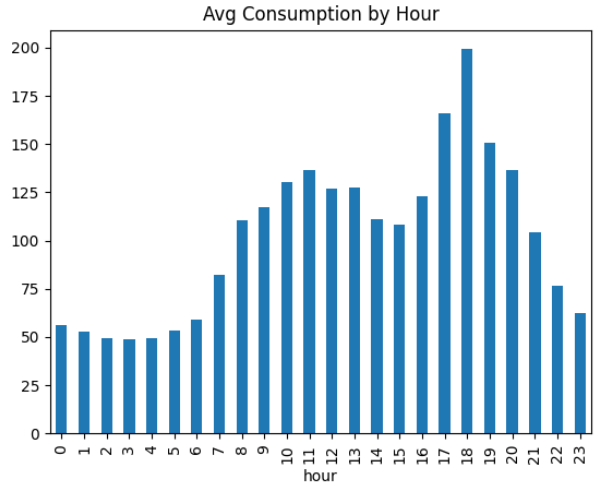
5.Forecasting (Baseline)

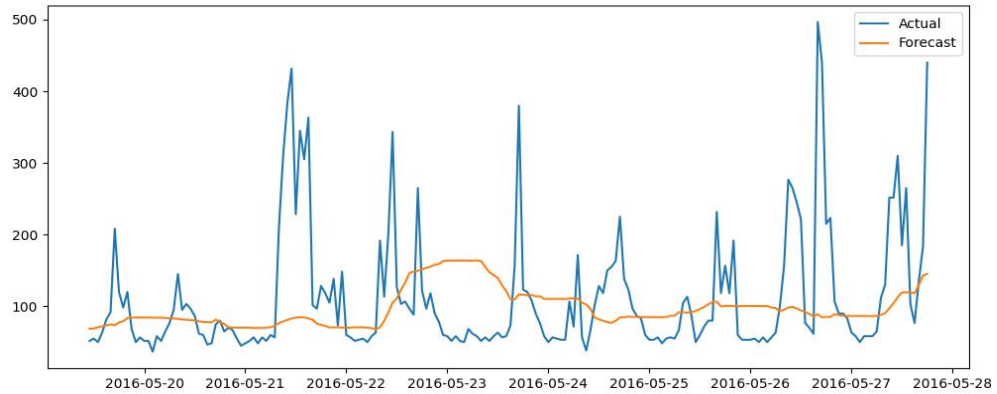
1. 24-hour moving average model

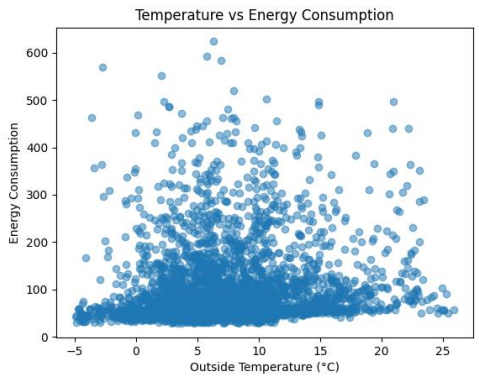
Key Insights :

- **Daily Patterns**: Usage peaks in evenings (6–8 PM).
- **Weekend vs Weekday**: Weekend avg = 104 units vs Weekday avg = 101 units.
- **Weather Effect**: Consumption rises when temp > 20°C (AC usage).
- **Top Usage Days**: Feb & April show extreme spikes.









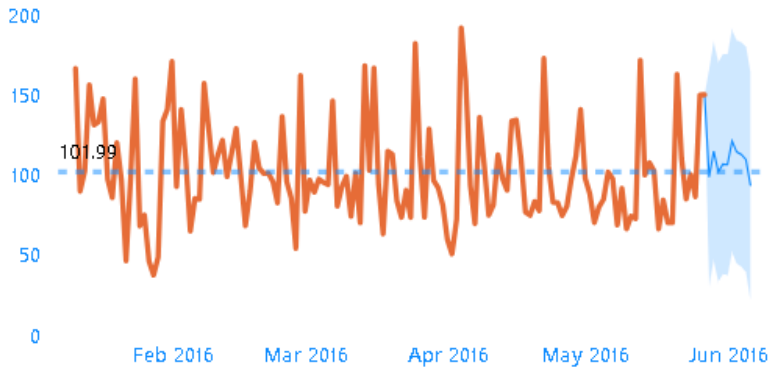
Dashboard:

Energy Intelligence: Big-Query & Power BI Driven Analysis

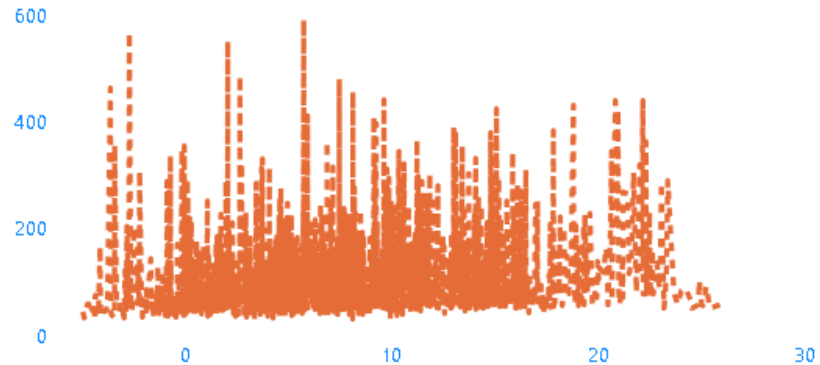
Date

11-01-2016 27-05-2016

Daily Average Consumption



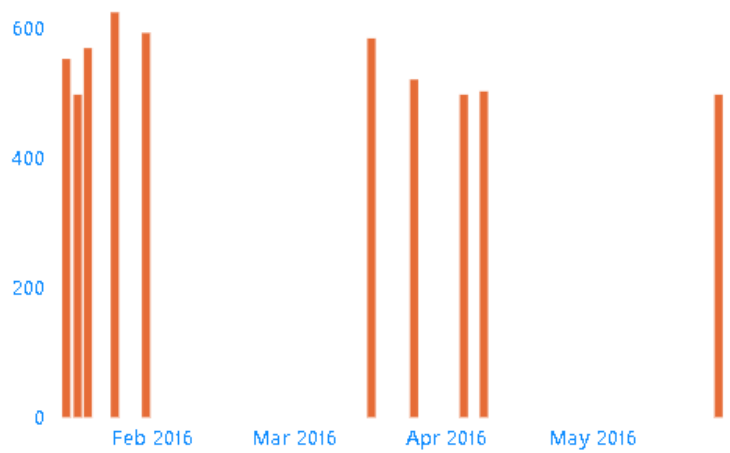
Weather vs Usage



Weekend vs Weekday

dayofweek	0	1	2	3	4	5	6	7
0	58.16	55.26	52.46	51.23	51.32	56.40	58.42	75.09
1	75.58	59.75	49.92	47.58	49.17	60.83	55.25	89.00
2	55.75	53.92	49.75	48.50	52.00	55.92	74.83	76.67
3	52.17	50.58	48.50	46.83	47.33	53.92	51.08	83.17
4	50.00	49.08	49.42	48.42	49.08	49.58	73.92	107.83
5	49.21	48.51	47.72	47.81	48.07	46.40	48.86	68.51
6	50.44	51.14	48.77	49.56	50.00	50.26	48.16	73.07
Total	**55.97**	**52.63**	**49.50**	**48.54**	**49.56**	**53.38**	**58.80**	**82.12**

Top 10 High Consumption Days



Min_Usage

28.33

avg_usage

101.58

Peak_Usage

660.00

Recommendations

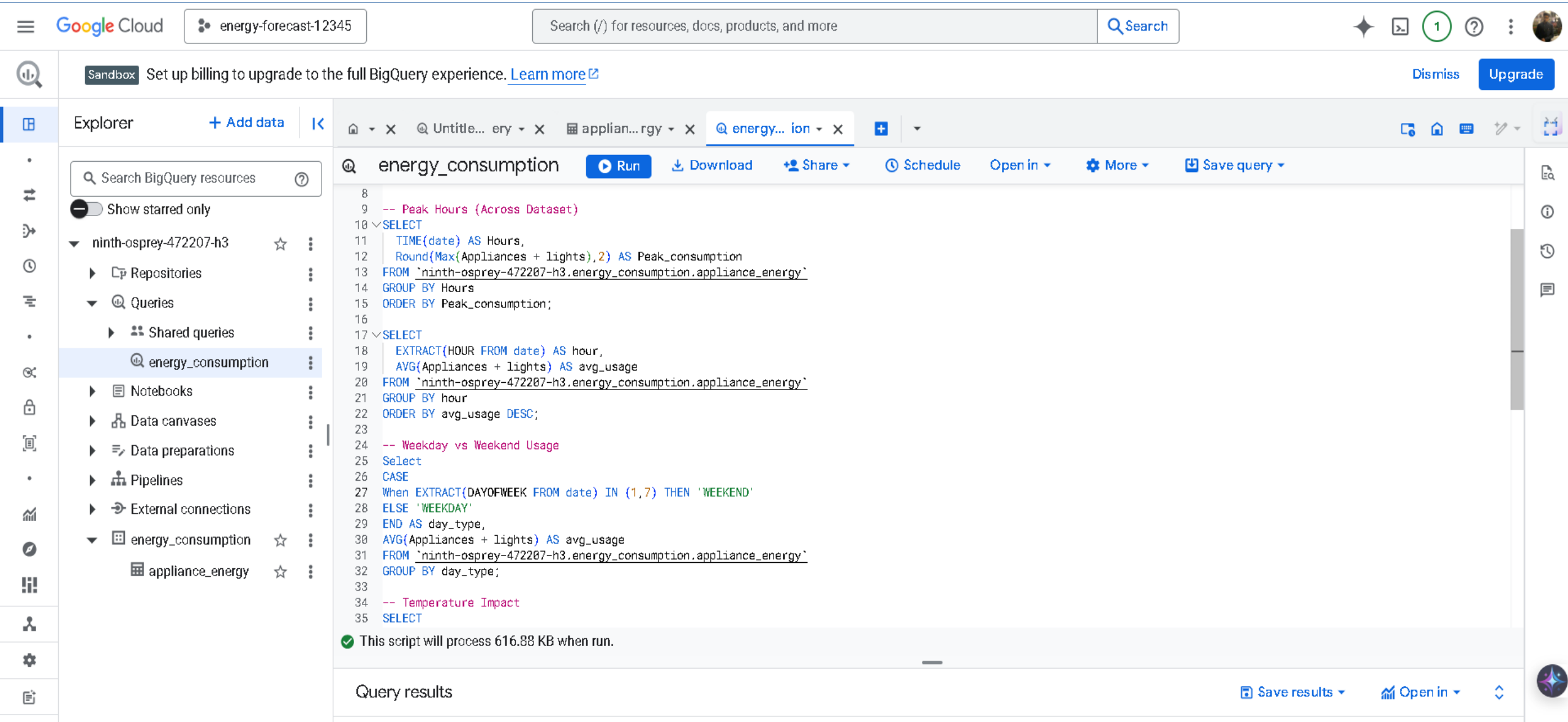
- Shift heavy appliance usage away from evening peaks.
- Consider renewable integration during high-demand hours.
- Alert system for abnormal consumption days.
- Future work: Improve forecasting using ML models (Prophet, Long Short-Term Memory).

Conclusion:

“The analysis provided clear patterns in energy usage, showing how weekdays vs weekends and weather conditions influence demand. The dashboards allow stakeholders to monitor usage effectively and take action to optimize energy costs.”

Appendix

- SQL queries (BigQuery)
- Python code snippets



Thank You (Lets Connect):
LinkedIn: https://www.linkedin.com/in/tanmay-sharma-800599373/
Git hub: https://github.com/Tanu272004
Project Link Home_Energy