

CSCI 622

Brock Gion

Electricity Consumption Explorer

Main Project Goals

Use data to...

1. Understand my electricity consumption patterns at home

On average, over the last 4 years my **monthly electric usage is ~745kwh/month**. That's the only metric I know going into this project

2. Reduce carbon footprint

While I'd like to use more renewable sources of energy (i. solar/wind), options are limited in North Dakota. So, step 1, looking to become more efficient with my energy usage, then use this data to size a solar pv system FY2025.

	A	D	G	I
1	Bill Date	Electric Usage	Electric Charges	
2	08/29/2024	702	95.16	
3	07/31/2024	758	96.87	
4	07/05/2024	824	107.93	
5	06/02/2024	716	83.19	
6	05/01/2024	619	76.64	
7	04/02/2024	122	76.1	
8	03/05/2024	642	80.18	
9	02/04/2024	719	84.7	
10	01/03/2024	664	81.25	
11	12/03/2023	842	95.4	
12	10/31/2023	634	78.21	
13	10/02/2023	719	93.95	
14	08/31/2023	730	97.39	
15	08/02/2023	742	96.62	
16	07/04/2023	797	103.52	
17	06/04/2023	829	95.43	
18	05/03/2023	677	80.98	
19	04/04/2023	537	67.42	
20	03/06/2023	620	77.3	
21	02/02/2023	681	85.55	
22	01/03/2023	858	104.97	
23	11/30/2022	681	87.15	
24	10/30/2022	703	90.89	
25	09/29/2022	823	117.13	
26	08/30/2022	803	114.11	
27	08/01/2022	869	120.14	
28	06/30/2022	857	115.41	
29	06/01/2022	811	98.25	
30	05/02/2022	719	88.61	
31	04/03/2022	752	96.15	
32	03/03/2022	783	97.92	
33	02/01/2022	770	99.05	
34	01/03/2022	788	94.32	
35	11/30/2021	727	89.44	
36	10/28/2021	664	79.34	
37	09/29/2021	717	105.74	
38	08/30/2021	821	112.14	
39	08/01/2021	1139	152.64	
40	06/30/2021	893	112.95	
41	06/01/2021	786	94.96	
42	05/02/2021	782	86.22	
43	04/01/2021	560	72.76	
44	03/03/2021	759	87.75	
45	02/01/2021	792	96.58	
46	01/03/2021	1056	104.25	
47	11/30/2020	793	86.82	
48	10/28/2020	794	82.47	
49	09/29/2020	706	89.59	
50		745	\$94.41	
51				

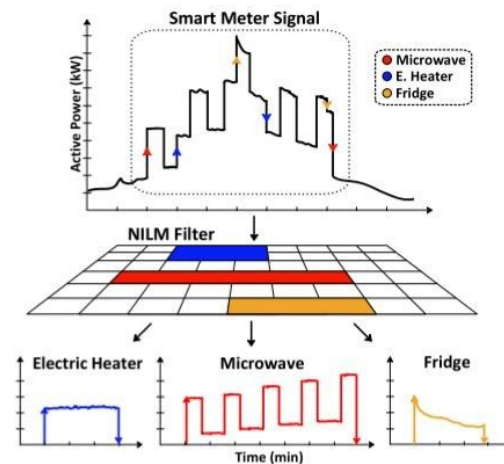
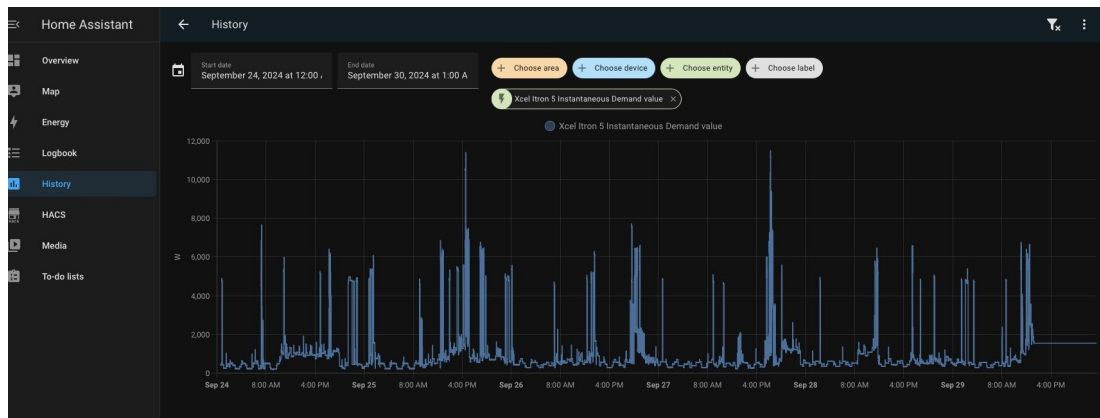
Other “Data-Centric” Goals

Expand on the data to...

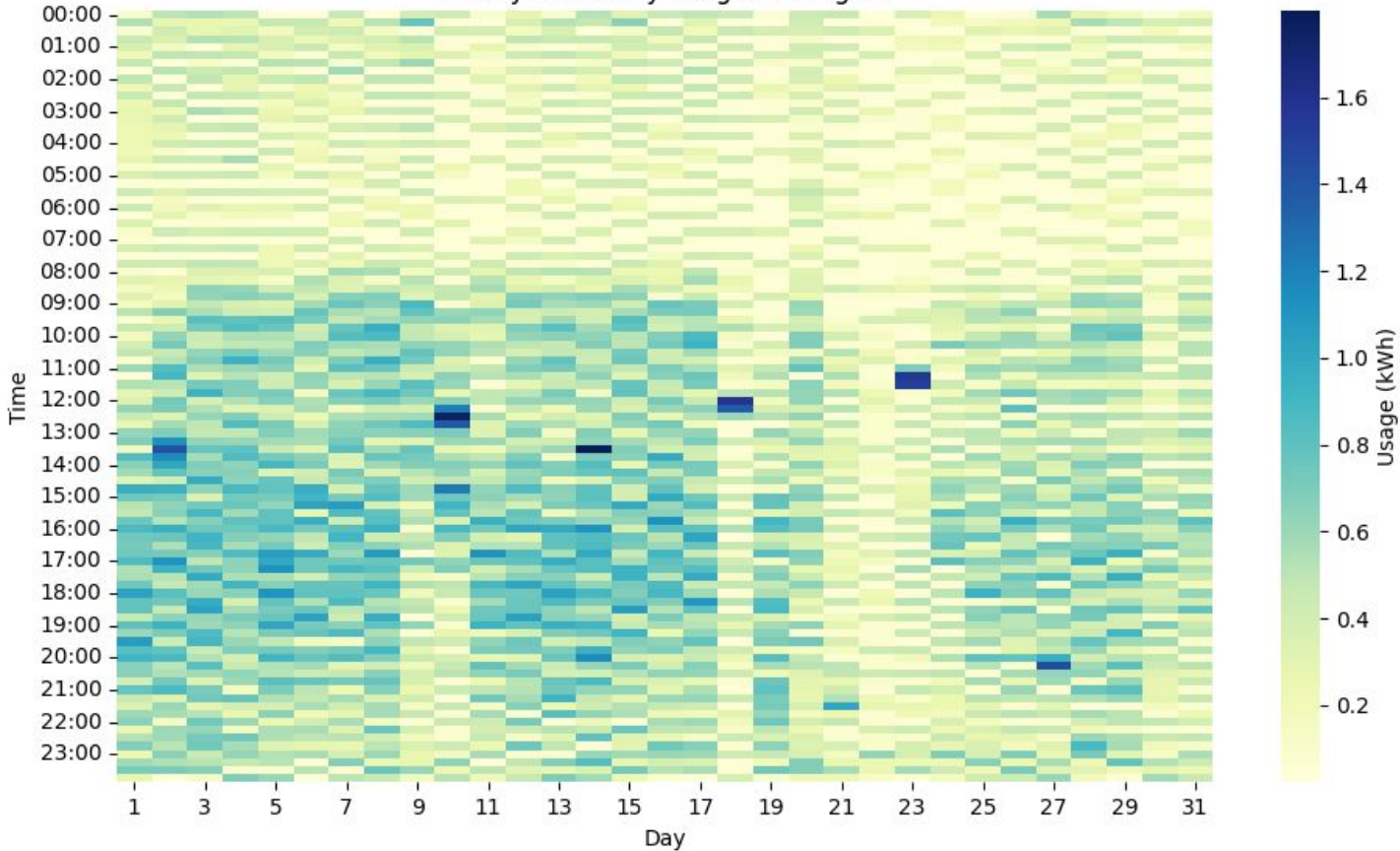
1. Create a dataset suitable for Machine Learning

Learn what it takes to engineer a system that’s appropriate for Machine Learning to detect patterns in my data. Ideally, want the ability to perform “**non-intrusive load monitoring**”.

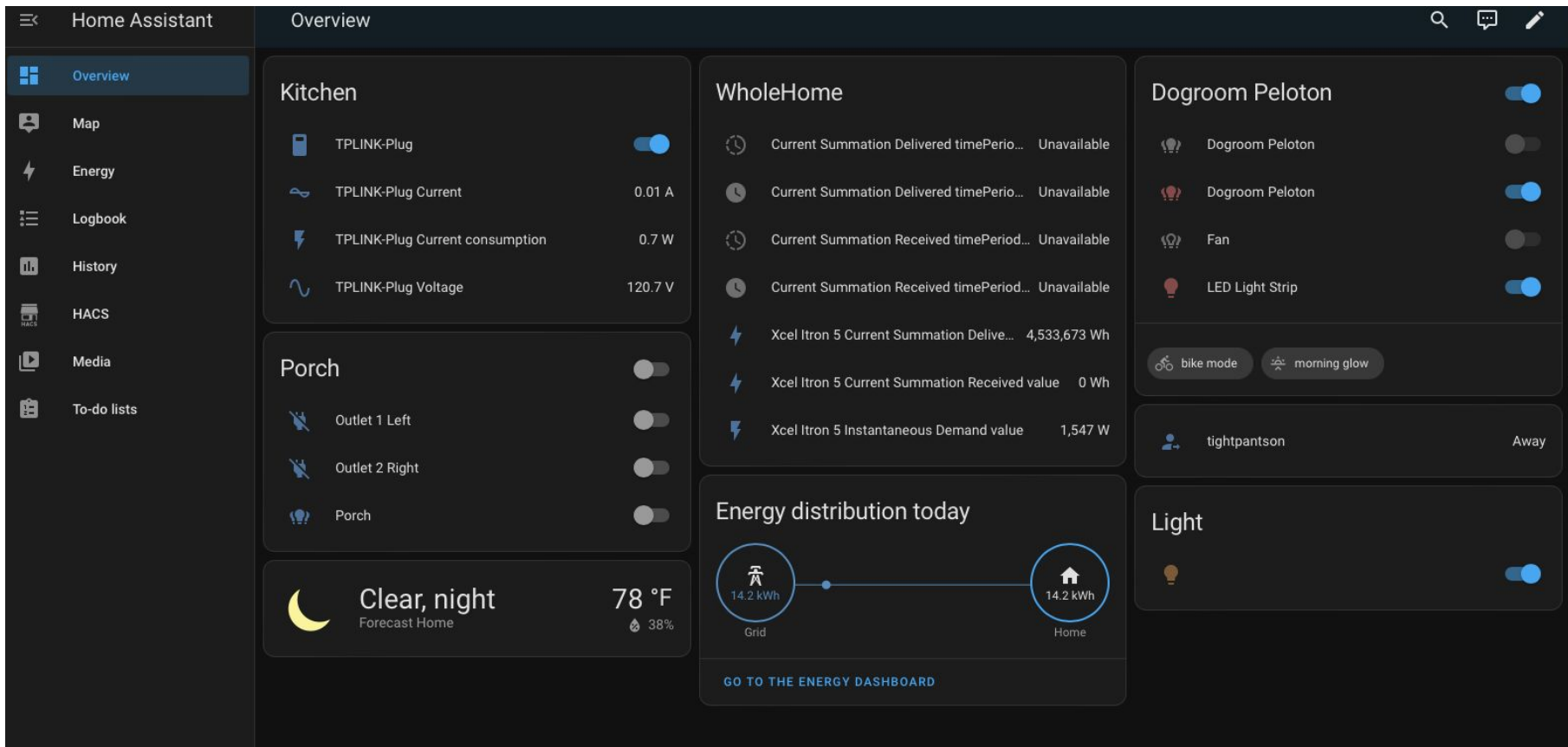
https://en.wikipedia.org/wiki/Nonintrusive_load_monitoring



Hourly electricity usage for August



Home Assistant setup



Main DataSource - iTron Electric Meter

- Electric meter installed at my house
- Utility provider is Xcel Energy
- This is a “smart meter” which takes interval readings of electric usage every 15 seconds (by default)
- As of August 2024 (1 month ago), now have the ability do directly access the direct straight from the meter



Other Datasources - EPA.gov

- <https://www.epa.gov/egrid/download-data>
- The “Power Profile” breaks down the estimated emissions, based on how your electricity source is provided

Power Profiler

i Updated with 2022 eGRID data!


[Español](#)

How clean is the electricity you use?

Electricity is produced by many different sources of energy, including, but not limited to, wind, solar, nuclear, and fossil fuels. The type and amount of emissions produced depend on how electricity is generated in your region. Type in your zip code (or select a region) to view your power profile. [More information](#)

Power Profiler

Enter zip code:



eGRID Subregions [More information](#)



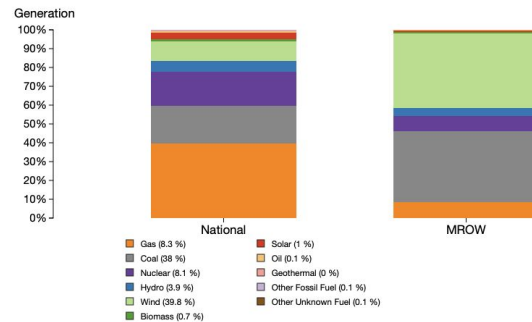
MROW Emission Rates

CO₂ 936.5 (lbs/MWh)	SO₂ 0.907 (lbs/MWh)	NO_x 0.758 (lbs/MWh)
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[Back to all subregions](#)

Fuel Mix

This chart compares fuel mix (%) of sources used to generate electricity in the selected [eGRID subregion](#) to the national fuel mix (%).



eGRID

Other Datasources - Our World in Data

- <https://ourworldindata.org/energy-production-consumption>
- Our World in Data provides a plethora of information related to energy
- Will help answer the question of how much energy do I consume vs. the average in the U.S?

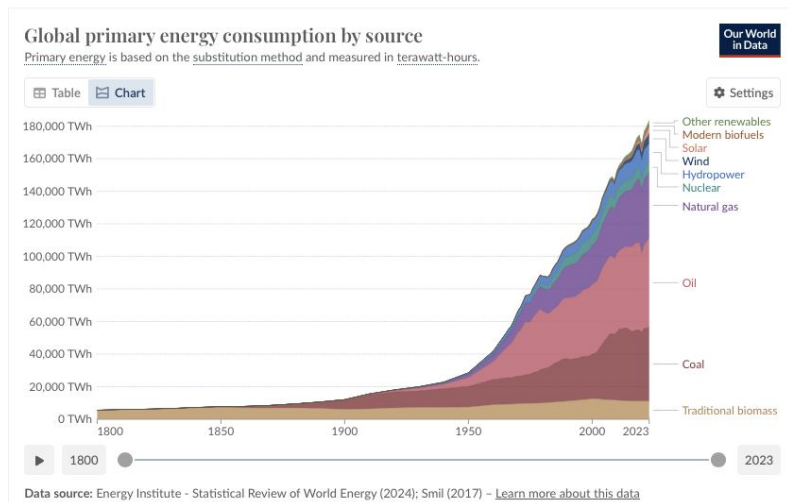
Global energy consumption

How much energy does the world consume?

The energy system has transformed dramatically since the Industrial Revolution. We see this transformation of the global energy supply in the interactive chart shown here. It graphs global energy consumption from 1800 onwards.

It is based on historical estimates of primary energy consumption from Vaclav Smil, combined with updated figures from BP's [Statistical Review of World Energy](#).¹

Note that this data presents primary energy consumption via the "substitution method". The substitution method — in comparison to the direct method — attempts to correct for the inefficiencies (energy wasted as heat during combustion) in fossil fuel and biomass conversion. It does this by correcting nuclear and modern renewable technologies to their "primary input equivalents" if the same quantity of energy was produced from fossil fuels.



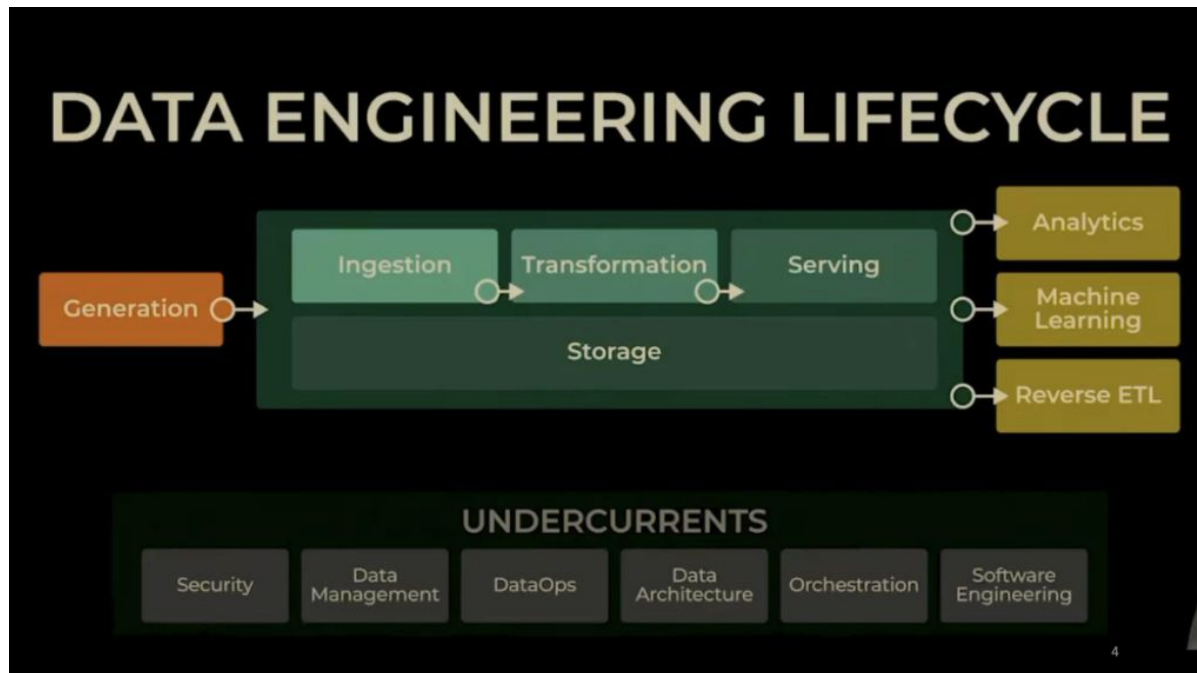
Key considerations Fundamentals of Data engineering

Security

- Using Home Assistant, access is managed through a login. Wifi network credentials matter, keeping communication on own network (Mtr-Rdr2G).
- Principle of least privilege.

Data Management

- Capturing key metadata events. Understanding dataset is time-series based, so crucial to understand the “gaps” in the data.
 - For example, if Home Assistant is down, or meter can’t communicate, how to handle this for analysis?
- How is the data defined and measured? difference between kwh and kwhr.



Key considerations Fundamentals of Data engineering

DataOps

- What can be automated? Any need for CI/CD? How are repos tied into this? Will results be publically shared?

Data Architecture

- How does this solution scale? If interval readings are happening every 15 seconds, what's the benefit of capturing every 5 seconds?
- How many users need to access the data?

Orchestration

- Any daily/weekly/quarterly “batch” processes for analyzing the data?

Software engineering

- What code will be used? Any plans to implement code as infrastructure?
- How is data quality quality assurance performed?

