Better Operational Decisions Leveraging Wholesale Power Market Data

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Agenda

- Intro to Power Market Data & Ways to Access It
- Example 1: An ERCOT Utility Using UI Tools to Make Decisions
- Example2: An ERCOT Utility using data tools to make decisions
- Example 3: Real World Workflows from Black Hills Energy

Intro to Power Market Data & Ways to Access It

Utilities must leverage LOTS of data in various business decisions

Power Plant Operations Data

And Much More

Meter / Billing Data

Wholesale Power Market Data

Utilities Have Varying Levels of Value for Power Market Data

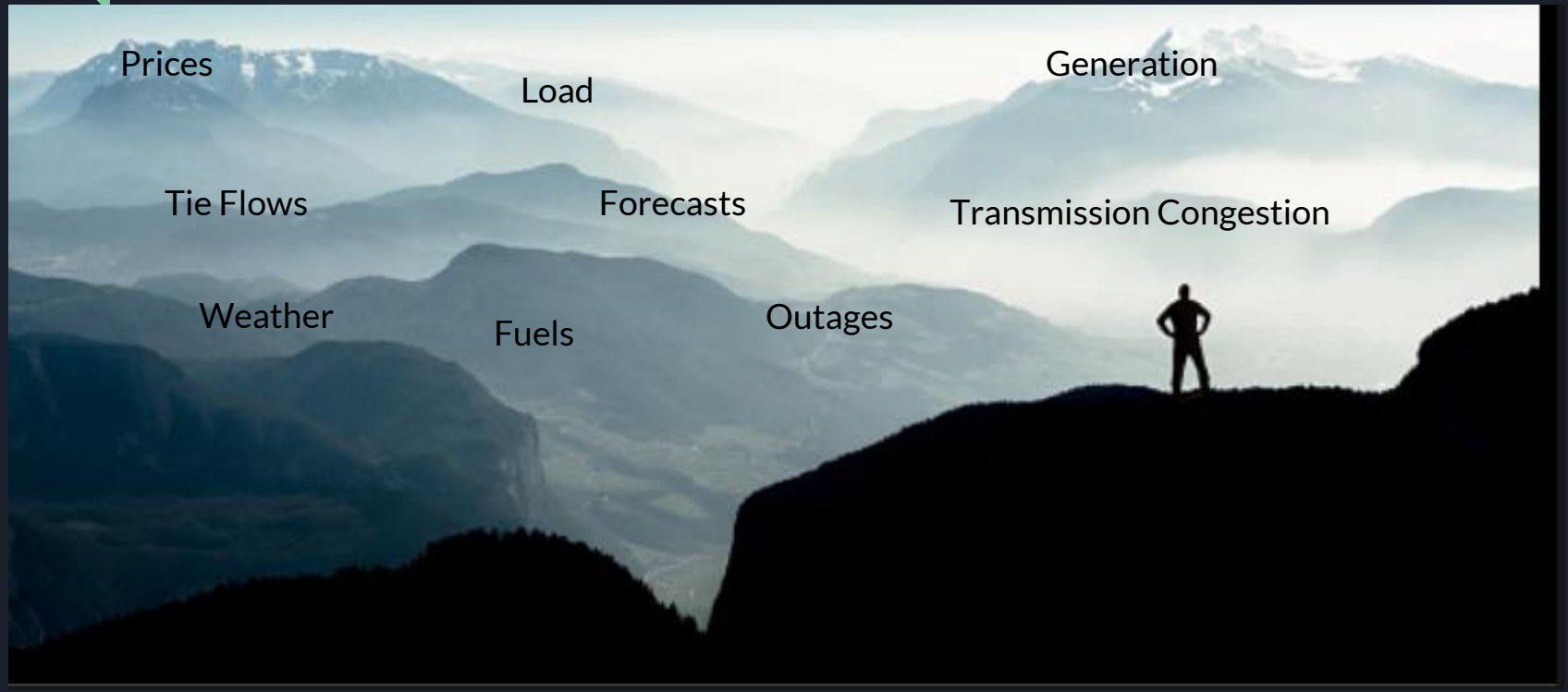
Example Utility A:
- IOU in an ISO Market
- Large Fleet of Plants Under Management

Leverages Power Market Data to:
- Understand Market Conditions for next few days
- Optimally Dispatch Plants
- Understand Congestion & Outages in their area
- Negotiate Long Term Power Buys & Sells
- Manage Congestion through FTR / ARR / CRRs

Example Utility B:
- Municipal Utility Outside an ISO Region
- No Plants under management

Leverages Power Market Data to:
- Occasionally buy & sell power from neighboring ISO

There's a lot of Power Market Data Out There



Much of it is publicly available, but not easy to access & analyze

Friendly Name	Posted	Available Files
LMPSELECTBUSNP6787_20221013_152014_csv	10/13/2022 3:20:18 PM	zip
LMPSELECTBUSNP6787_20221013_152014_xml	10/13/2022 3:20:18 PM	zip
LMPSELECTBUSNP6787_20221013_151514_csv	10/13/2022 3:15:18 PM	zip
LMPSELECTBUSNP6787_20221013_151514_xml	10/13/2022 3:15:18 PM	zip
LMPSELECTBUSNP6787_20221013_151014_csv	10/13/2022 3:10:1	
LMPSELECTBUSNP6787_20221013_151014_xml	10/13/2022 3:10:1	
LMPSELECTBUSNP6787_20221013_150514_csv	10/13/2022 3:05:1	
LMPSELECTBUSNP6787_20221013_150514_xml	10/13/2022 3:05:1	
LMPSELECTBUSNP6787_20221013_150017_csv	10/13/2022 3:00:2	
LMPSELECTBUSNP6787_20221013_150017_xml	10/13/2022 3:00:2	
LMPSELECTBUSNP6787_20221013_145513_csv	10/13/2022 2:55:1	
LMPSELECTBUSNP6787_20221013_145513_xml	10/13/2022 2:55:1	
LMPSELECTBUSNP6787_20221013_145013_csv	10/13/2022 2:50:1	

Binding Constraints Supplemental Readers' Guide

Binding Constraints Supplemental (xls)

Showing 1-10 of 1017 documents « ‹ 1 2 3 4 5 › » 10 per page

File	Published
20221013_da_bcsf.xls	10/13/2022
20221012_da_bcsf.xls	10/12/2022
20221011_da_bcsf.xls	10/11/2022
20221010_da_bcsf.xls	10/10/2022
	10/9/2022
	10/8/2022
	10/7/2022
	10/6/2022
	10/5/2022
	10/4/2022

information contained therein at your/the company's own risk. Accordingly, you/your compa
its use of the data in the Transmission Facilities Outage List, and neither PJM nor any wh
their successors and assigns, agents, contractors, service providers or vendors shall be l
by you/your company as relates to the use of the referenced information obtained from the
Information on file contents available at www.pjm.com > Markets & Operations > PJM Tools >

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DE-ENERGIZED EQUIPMENT                                                          |
--------------------------------------------------------------------------------|
ITEM   TICKET   FACILITY NAME                                                   |
--------------------------------------------------------------------------------|
    1        0 BRKR INDIANRI 230 KV  INDIANRI 231 CB                            |
--------------------------------------------------------------------------------|
    2        0 CAP  BARBADOS 35 KV   BARBADOS 20-2 CAP   CAP                    |
--------------------------------------------------------------------------------|
    3        0 CAP  BARBADOS 35 KV   BARBADOS 11-1 CAP   CAP                    |
--------------------------------------------------------------------------------|
    4        0 CAP  BARBADOS 35 KV   BARBADOS 11-2 CAP   CAP                    |
--------------------------------------------------------------------------------|
    5        0 CAP  BARBADOS 35 KV   BARBADOS 20-1 CAP   CAP                    |
--------------------------------------------------------------------------------|
    6        0 CAP  CALLOWHI 13 KV   CALLOWHI 8-2   CAP                         |
--------------------------------------------------------------------------------|
    7        0 CAP  CALLOWHI 13 KV   CALLOWHI 8-1   CAP                         |
--------------------------------------------------------------------------------|
    8        0 CAP  CALLOWHI 13 KV   CALLOWHI 4-3   CAP                         |
--------------------------------------------------------------------------------|
    9        0 CAP  CALLOWHI 13 KV   CALLOWHI 4-2   CAP                         |
--------------------------------------------------------------------------------|
```

North America's Trusted Power Market Data Provider

North American Power Market Data

pjm
SPP Southwest Power Pool
ercot
MISO
ISO new england
California ISO
ieso Connecting Today. Powering Tomorrow.
aeso
CENACE Centro Nacional de Control de Energía
New York ISO Independent System Operator

Public Data

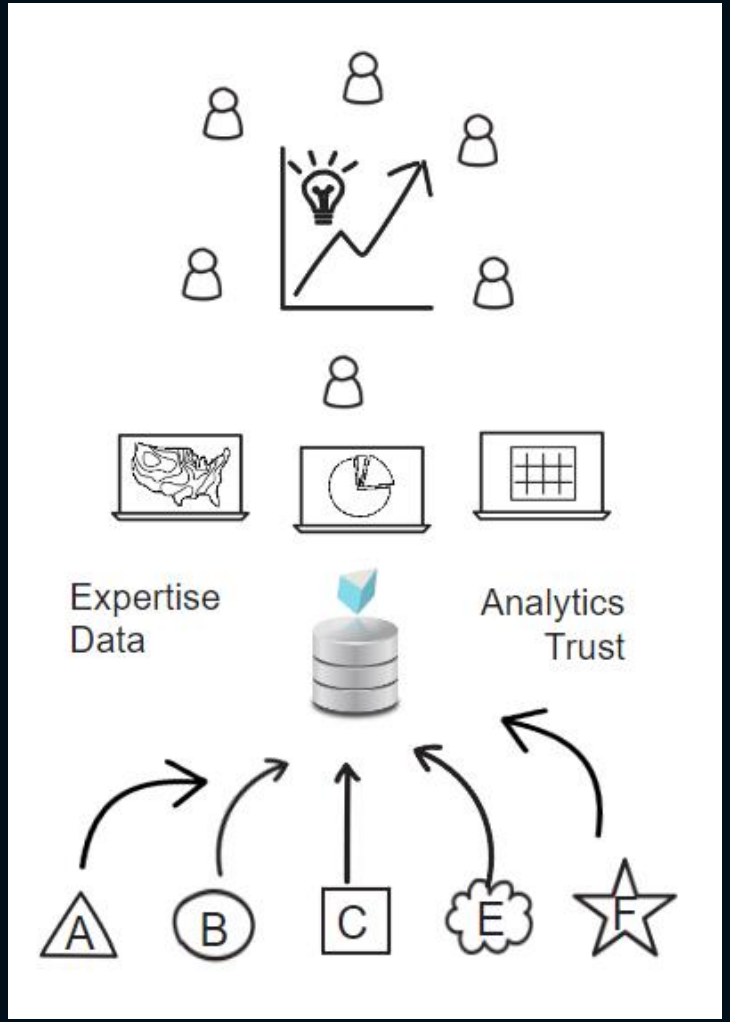
CIMIS
eia
United States Environmental Protection Agency
U.S.NRC
National Weather Service

3rd Party Partners & Premium Content

LIVE POWER
TESLA
iir energy
Atmospheric G2
VAISALA
ENVERUS Creating the future of energy together.

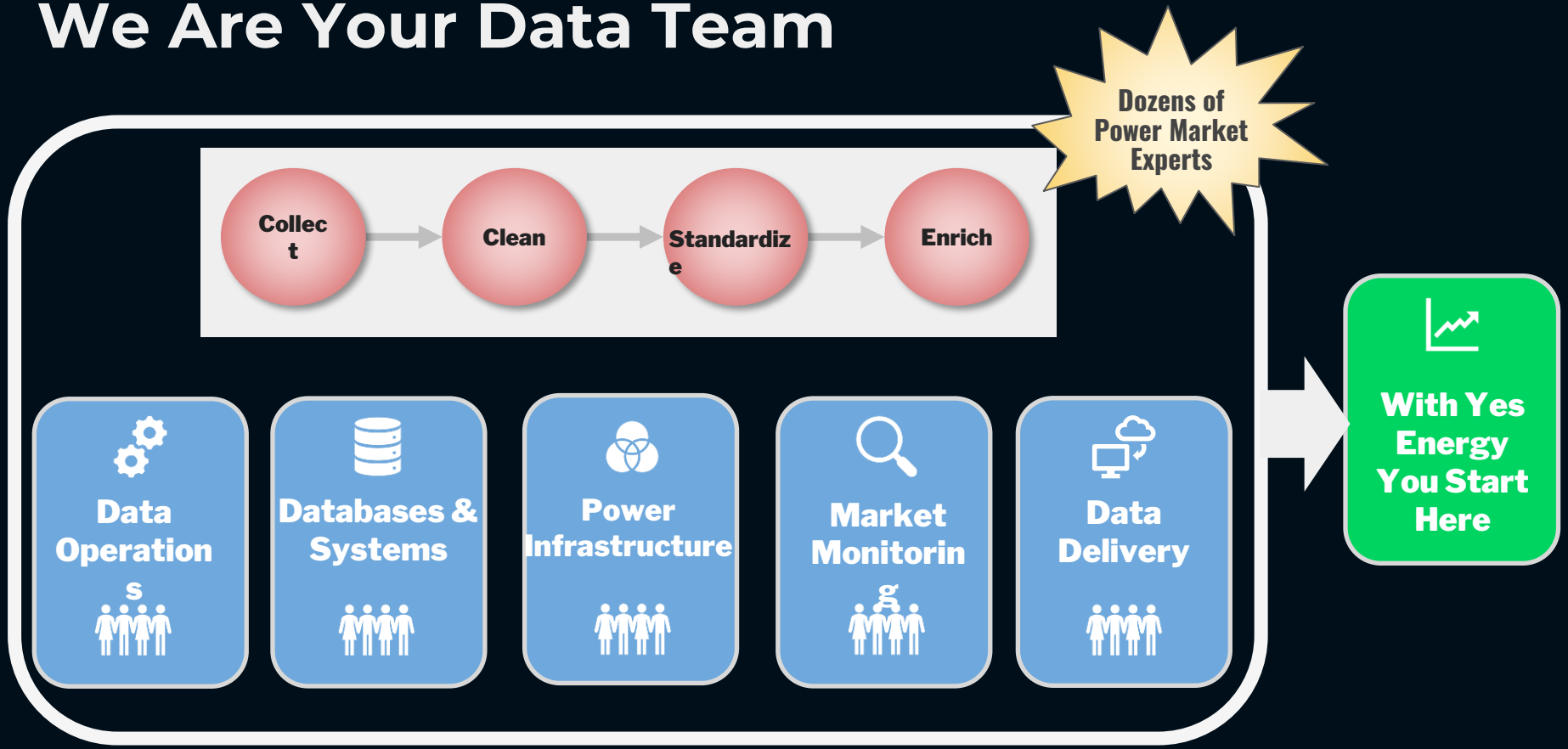
YES ENERGY

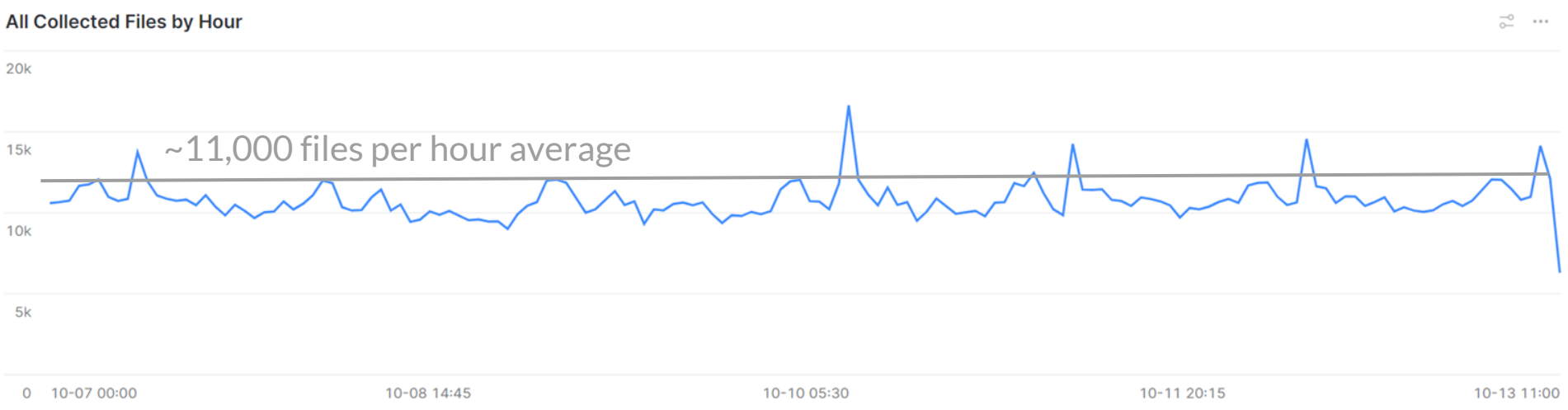
What Yes Energy does for you



Data → Insight

We Are Your Data Team

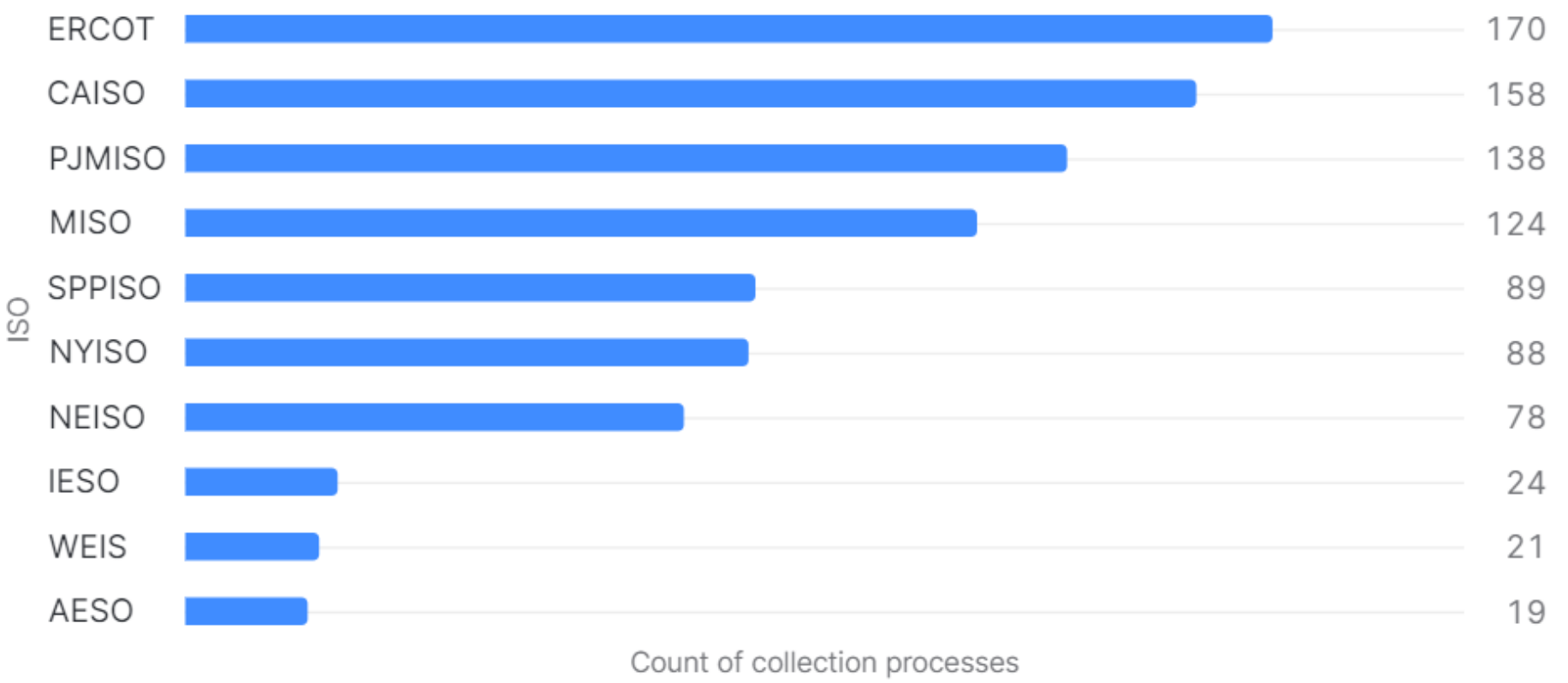



All Collected Files by Hour
20k
15k
10k
5k
0
~11,000 files per hour average
10-07 00:00
10-08 14:45
10-10 05:30
10-11 20:15
10-13 11:00

Count of daily "bad file" errors from the ISOs

Date	ISO						
	CAISO	ERCOT	MISO	NEISO	NYISO	PJMISO	SPPISO
10-09	33	417	455	3	8	291	145
10-10	27	370	333	2	7	301	147
10-11	24	270	842	2	7	293	145
10-12	28	463	424	2	20	297	142
10-13	15	451	434	1	26	135	74

Count of unique collection processes by ISO



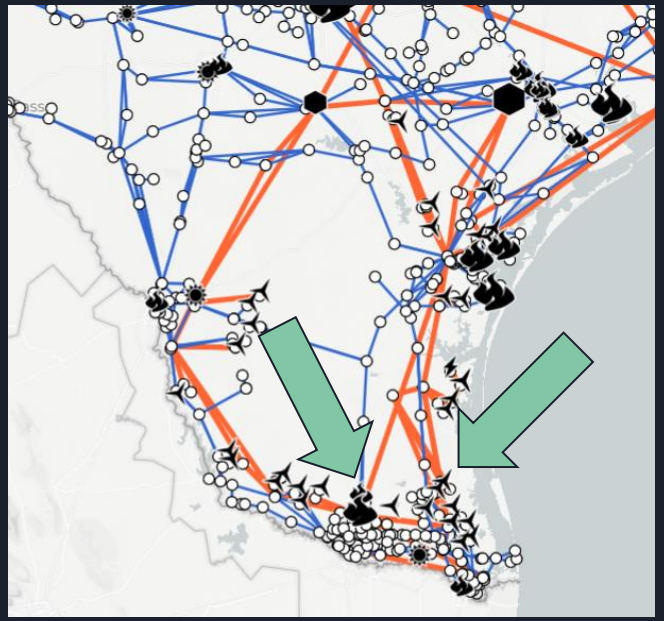
86,400 collection attempts per hour for 15 second data

6 major ISO website changes in 2021

150 hours of data-related support questions a month

Example 1: An ERCOT Utility Using UI Tools to Make Decisions

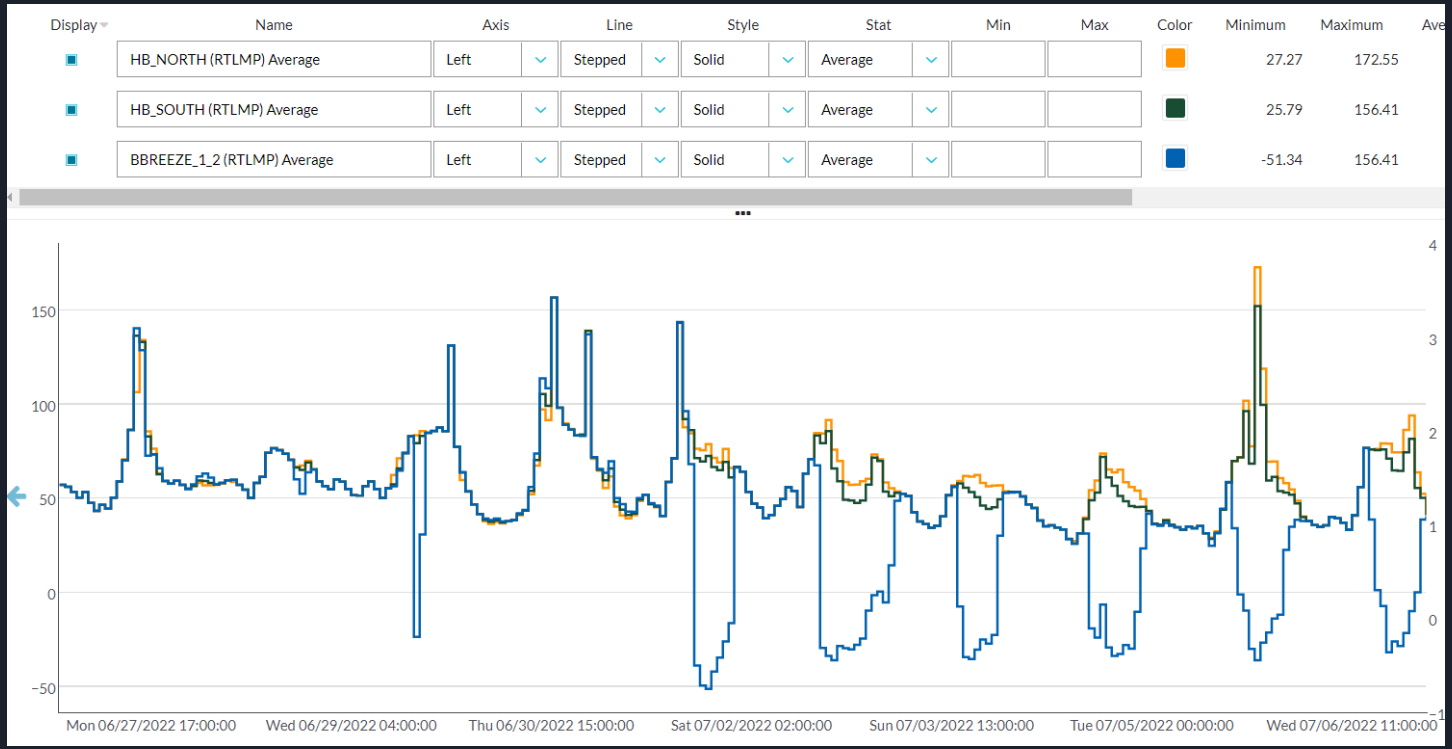
The Situation: I’m a utility in South Texas. I manage a wind farm (Breunnings Breeze) and a peaker plant (Red Gate)



It's the morning of 7/7/22, I want to use market data to understand:

1. Why there have been recent negative prices at Breunnings Breeze Wind
2. If there is going to be a price spike tomorrow to we can turn on the Red Gate Peaker and take advantage of those prices

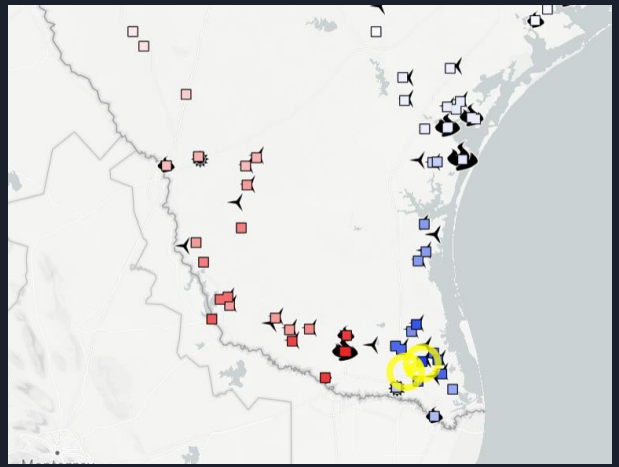
1. Why there have been recent negative prices at Breunnings Breeze Wind

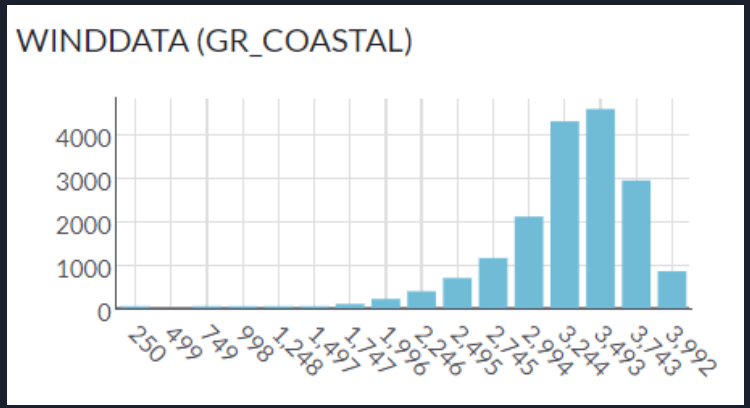


Display	Name	Axis	Line	Style	Stat	Min	Max	Color	Minimum	Maximum	Ave
■	HB_NORTH (RTLMP) Average	Left	Stepped	Solid	Average				27.27	172.55	
■	HB_SOUTH (RTLMP) Average	Left	Stepped	Solid	Average				25.79	156.41	
■	BBREEZE_1_2 (RTLMP) Average	Left	Stepped	Solid	Average				-51.34	156.41	

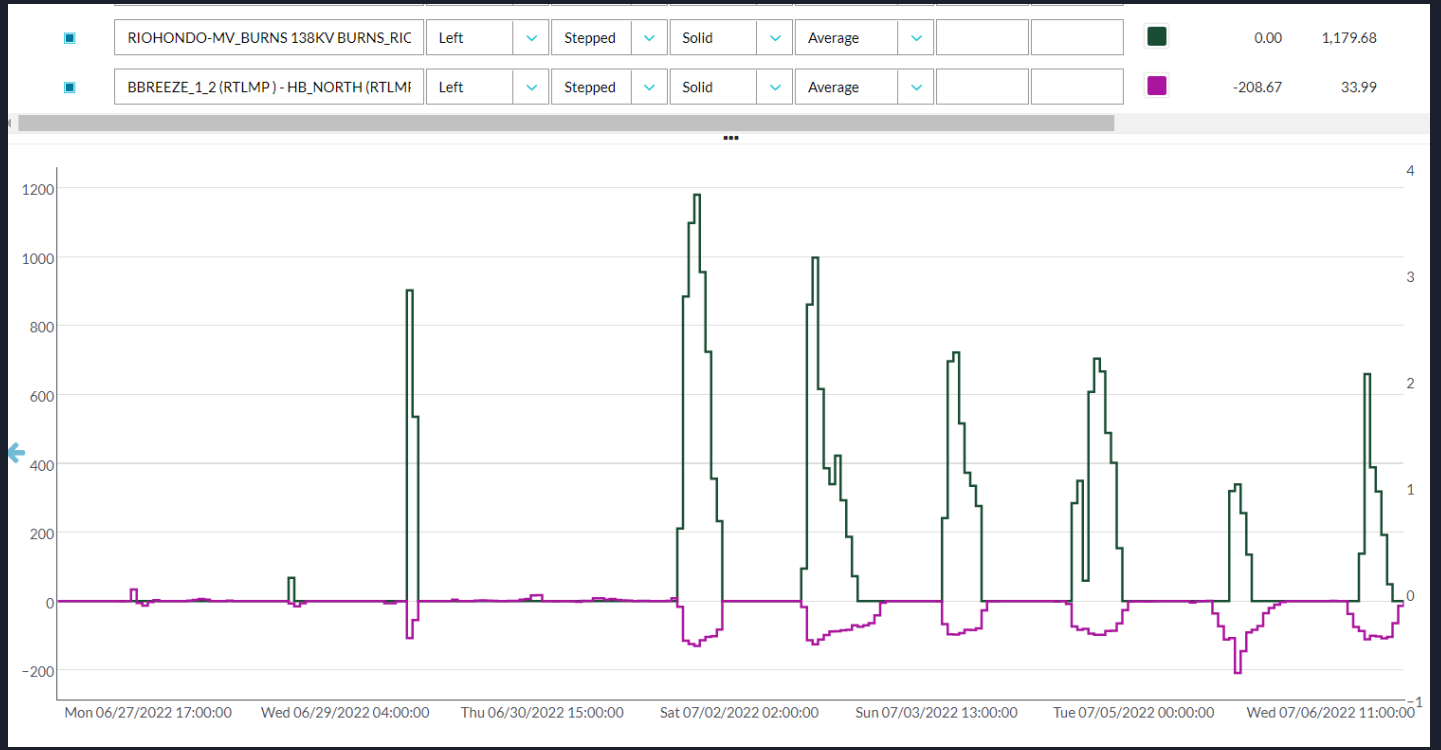
Analyze transmission congestion that has led to price separation, ID those congestion drivers

Constraint	From Zone	To Zone	Hrs	% Hrs	Total $	Avg $	Max $	Shift Factor Exposure
RIOHONDO-MV_BURNS 138KV BURNS_RIOH...	SOUTH	SOUTH	54.00	37.50	19,571.80	135.92	1,179.68	-14.17
NELRIO	SOUTH	SOUTH	83.00	57.64	1,274.29	8.85	85.41	-8.85
LARDVNTH-LASCRUCE 138KV LARDVN_LASCR...	SOUTH	SOUTH	59.00	40.97	11,890.04	82.57	1,034.21	-6.70
PILONCIL-CATARINA 138KV CATARI_PILONC1_1	SOUTH	SOUTH	56.00	38.89	9,033.94	62.74	1,253.27	-3.43

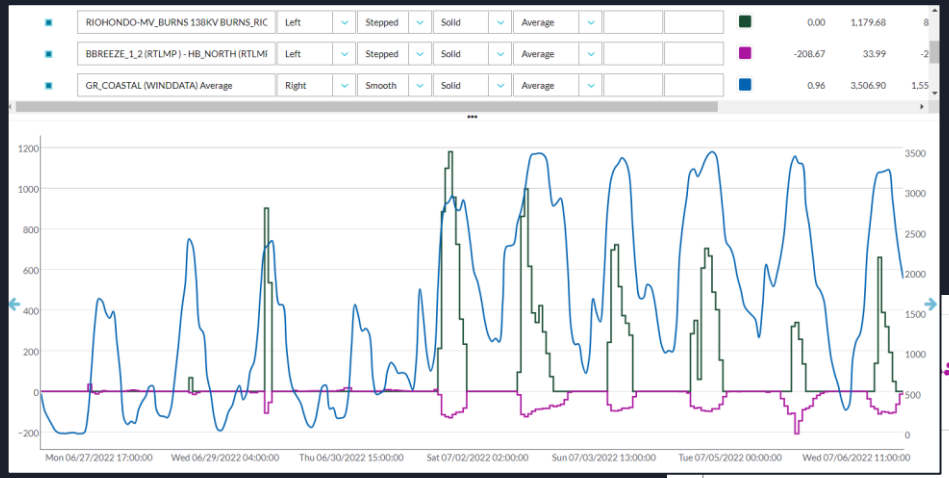


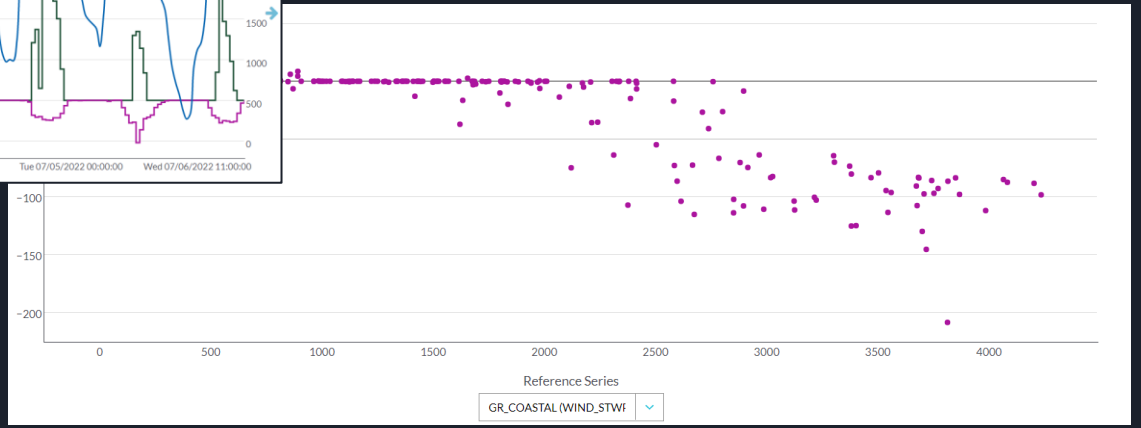


North -> BB Congestion Price Spread (Purple) v. Rio Hondo - Burns Shadow Price (Green)



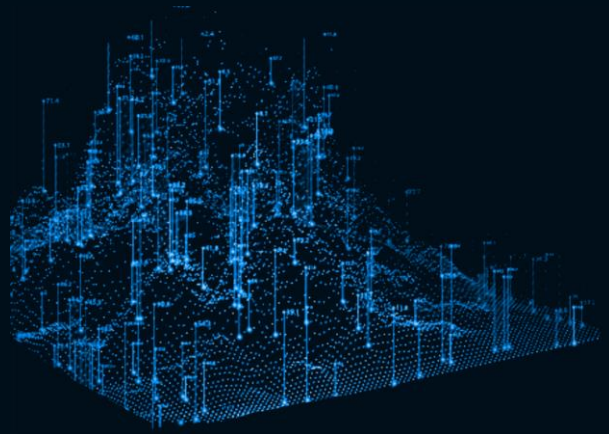
With Coastal Wind Overlayed....





DataSignals

All the power market data you need everywhere you need it



DS API

REST API for reporting and automated processing

Amazon S3 files great for internal data warehousing

DS LAKE

DS CLOUD

Cloud SQL database on Snowflake platform (available on AWS, Azure, Google)

Marry Yes Energy data with your own data

DATETIME	Load Forecast (MW)	Wind Forecast (MW)	Solar Forecast (MW)
2022-10-13 08:00:00.000	43,055.920166	8,521.9	72.1
2022-10-13 09:00:00.000	43,186.349609	7,151.7	1,899.1
2022-10-13 10:00:00.000	44,388.25	4,529.5	6,808.8
2022-10-13 11:00:00.000	46,304.570129	4,039.8	8,710
2022-10-13 12:00:00.000	48,588.475341	3,478	8,484.1
2022-10-13 13:00:00.000	51,351.949584	2,546.8	7,993.5
2022-10-13 14:00:00.000	53,712.400634	1,990.7	8,150.4
2022-10-13 15:00:00.000	55,970.799438	1,630.2	7,961.6
2022-10-13 16:00:00.000	57,734.731201	2,584.1	7,675.9
2022-10-13 17:00:00.000	58,860.749511	3,491.6	6,838

Datetime (minute)	SCADA
2022-10-13 00:00:00.000	138.5525
2022-10-13 00:01:00.000	73.36
2022-10-13 00:02:00.000	280.8075
2022-10-13 00:03:00.000	365.9275
2022-10-13 00:04:00.000	112.345
2022-10-13 00:05:00.000	78.54
2022-10-13 00:06:00.000	70.37
2022-10-13 00:07:00.000	217.1425
2022-10-13 00:08:00.000	357.7925
2022-10-13 00:09:00.000	582.375

Excellent for historical big data analysis

SP15 Hub Historical Median LMPs ($/MWh)

	Fall	Spring	Summer	Winter
2018	33.49	22.06	32.04	33.99
2019	32.95	22.01	26.94	40.66
2020	31.55	20.76	23.17	28.73
2021	53.2	29.18	46.84	38.16
2022	71.03	50.73	75.06	46.84