Wind Energy Investment Profile

Technical Report

Max Kuchynski

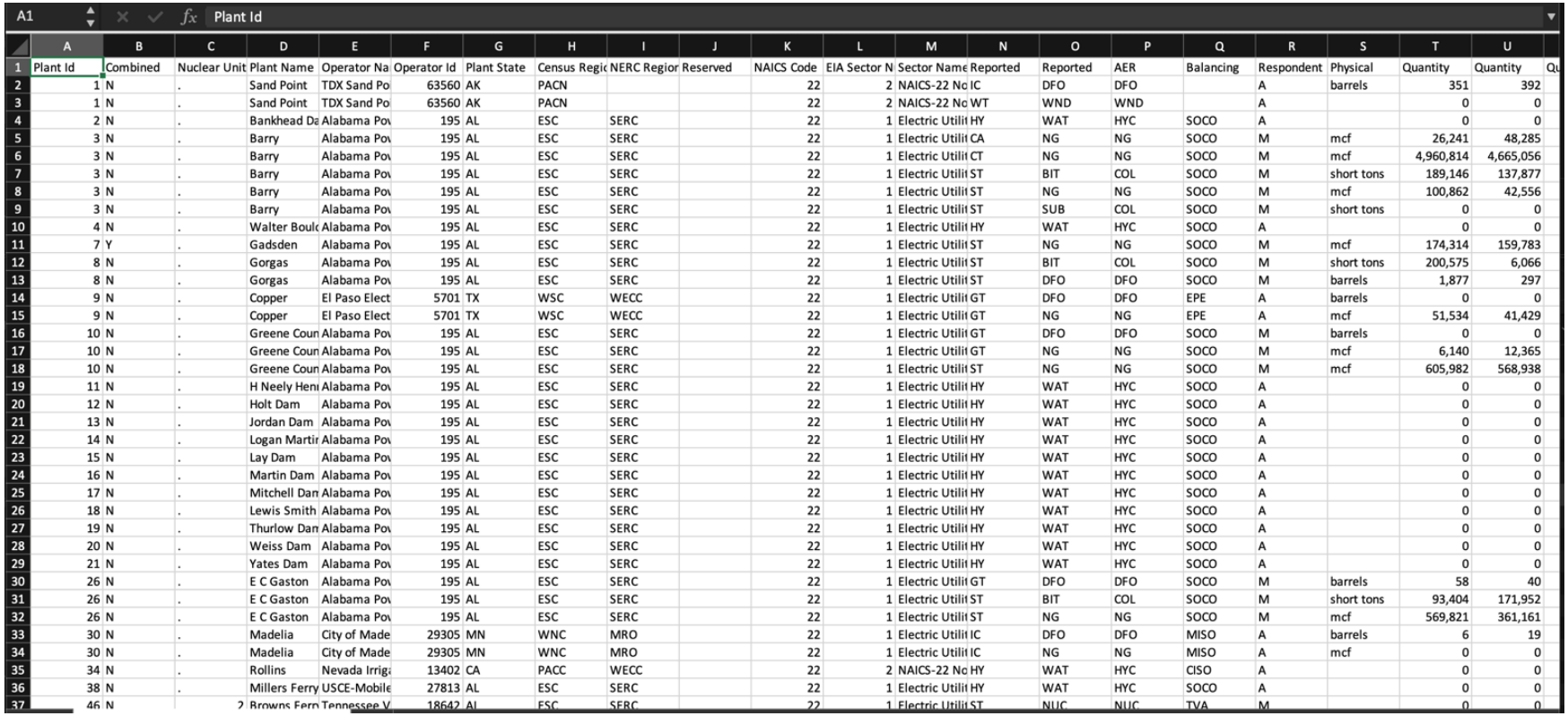
To work on the project, we must use the data from the ea.com website. The data contains the names of the operators' companies and amount of generated electricity by each company. Download the databases form https://www.eia.gov/electricity/data/eia923/

The data contains more than 14000 rows and 89 columns:

U.S. Department of Energy, The Energy Information Administration (EIA)
EIA-923 Monthly Generation and Fuel Consumption Time Series File, 2021 Data Early Release
Sources: EIA-923 and EIA-860 Reports

Plant Id	Combined Heat And Power Plant	Nuclear Unit Id	Plant Name	Operator Name	Operator Id	Plant State	Census Region	NERC Region	Reserved	NAICS Code	EIA Sector Number	Sector Name	Pr
2	N		Bankhead Dam	Alabama Power Co	195	AL	ESC	SERC		22	1	Electric Utility	HY
3	N		Barry	Alabama Power Co	195	AL	ESC	SERC		22	1	Electric Utility	CA
3	N		Barry	Alabama Power Co	195	AL	ESC	SERC		22	1	Electric Utility	CT
3	N		Barry	Alabama Power Co	195	AL	ESC	SERC		22	1	Electric Utility	ST
3	N		Barry	Alabama Power Co	195	AL	ESC	SERC		22	1	Electric Utility	ST
3	N		Barry	Alabama Power Co	195	AL	ESC	SERC		22	1	Electric Utility	ST
4	N		Walter Bouldin Dam	Alabama Power Co	195	AL	ESC	SERC		22	1	Electric Utility	HY
7	Y		Gadsden	Alabama Power Co	195	AL	ESC	SERC		22	1	Electric Utility	ST
9	N		Copper	El Paso Electric Co	5701	TX	WSC	WECC		22	1	Electric Utility	GT
9	N		Copper	El Paso Electric Co	5701	TX	WSC	WECC		22	1	Electric Utility	GT
10	N		Greene County	Alabama Power Co	195	AL	ESC	SERC		22	1	Electric Utility	GT
10	N		Greene County	Alabama Power Co	195	AL	ESC	SERC		22	1	Electric Utility	GT
10	N		Greene County	Alabama Power Co	195	AL	ESC	SERC		22	1	Electric Utility	ST
11	N		H Neely Henry Dam	Alabama Power Co	195	AL	ESC	SERC		22	1	Electric Utility	HY
12	N		Holt Dam	Alabama Power Co	195	AL	ESC	SERC		22	1	Electric Utility	HY
13	N		Jordan Dam	Alabama Power Co	195	AL	ESC	SERC		22	1	Electric Utility	HY
14	N		Logan Martin Dam	Alabama Power Co	195	AL	ESC	SERC		22	1	Electric Utility	HY
15	N		Lay Dam	Alabama Power Co	195	AL	ESC	SERC		22	1	Electric Utility	HY
16	N		Martin Dam	Alabama Power Co	195	AL	ESC	SERC		22	1	Electric Utility	HY
17	N		Mitchell Dam	Alabama Power Co	195	AL	ESC	SERC		22	1	Electric Utility	HY
18	N		Lewis Smith Dam	Alabama Power Co	195	AL	ESC	SERC		22	1	Electric Utility	HY
19	N		Thurlow Dam	Alabama Power Co	195	AL	ESC	SERC		22	1	Electric Utility	HY
20	N		Weiss Dam	Alabama Power Co	195	AL	ESC	SERC		22	1	Electric Utility	HY
21	N		Yates Dam	Alabama Power Co	195	AL	ESC	SERC		22	1	Electric Utility	HY
26	N		E C Gaston	Alabama Power Co	195	AL	ESC	SERC		22	1	Electric Utility	GT
26	N		E C Gaston	Alabama Power Co	195	AL	ESC	SERC		22	1	Electric Utility	ST
26	N		E C Gaston	Alabama Power Co	195	AL	ESC	SERC		22	1	Electric Utility	ST
30	N		Madelia	City of Madelia - (MN)	29305	MN	WNC	MRO		22	1	Electric Utility	IC
30	N		Madelia	City of Madelia - (MN)	29305	MN	WNC	MRO		22	1	Electric Utility	IC
34	N		Rollins	Nevada Irrigation District	13402	CA	PACC	WECC		22	2	NAICS-22 Non-Cogen	HY
38	N		Millers Ferry	USCE-Mobile District	27813	AL	ESC	SERC		22	1	Electric Utility	HY
46	N	1	Browns Ferry	Tennessee Valley Authority	18642	AL	ESC	SERC		22	1	Electric Utility	ST
46	N	3	Browns Ferry	Tennessee Valley Authority	18642	AL	ESC	SERC		22	1	Electric Utility	ST
46	N	2	Browns Ferry	Tennessee Valley Authority	18642	AL	ESC	SERC		22	1	Electric Utility	ST
47	N		Colbert	Tennessee Valley Authority	18642	AL	ESC	SERC		22	1	Electric Utility	GT
47	N		Colbert	Tennessee Valley Authority	18642	AL	ESC	SERC		22	1	Electric Utility	GT

Save this file as .csv file.



Plant Id	Combined	Nuclear Unit	Plant Name	Operator Na	Operator Id	Plant State	Census Regic	NERC Regior	Reserved	NAICS Code	EIA Sector N	Sector Name	Reported	Reported	AER	Balancing	Respondent	Physical	Quantity	Quantity	Qu
1	N	.	Sand Point	TDX Sand Po	63560	AK	PACN			22	2	NAICS-22 No	IC	DFO	DFO		A	barrels	351	392	
1	N	.	Sand Point	TDX Sand Po	63560	AK	PACN			22	2	NAICS-22 No	WT	WND	WND		A		0	0	
2	N	.	Bankhead Da	Alabama Pov	195	AL	ESC	SERC		22	1	Electric Utilit	HY	WAT	HYC	SOCO	A		0	0	
3	N	.	Barry	Alabama Pov	195	AL	ESC	SERC		22	1	Electric Utilit	CA	NG	NG	SOCO	M	mcf	26,241	48,285	
3	N	.	Barry	Alabama Pov	195	AL	ESC	SERC		22	1	Electric Utilit	CT	NG	NG	SOCO	M	mcf	4,960,814	4,665,056	
3	N	.	Barry	Alabama Pov	195	AL	ESC	SERC		22	1	Electric Utilit	ST	BIT	COL	SOCO	M	short tons	189,146	137,877	
3	N	.	Barry	Alabama Pov	195	AL	ESC	SERC		22	1	Electric Utilit	ST	NG	NG	SOCO	M	mcf	100,862	42,556	
3	N	.	Barry	Alabama Pov	195	AL	ESC	SERC		22	1	Electric Utilit	ST	SUB	COL	SOCO	M	short tons	0	0	
4	N	.	Walter Boulc	Alabama Pov	195	AL	ESC	SERC		22	1	Electric Utilit	HY	WAT	HYC	SOCO	A		0	0	
7	Y	.	Gadsden	Alabama Pov	195	AL	ESC	SERC		22	1	Electric Utilit	ST	NG	NG	SOCO	M	mcf	174,314	159,783	
8	N	.	Gorgas	Alabama Pov	195	AL	ESC	SERC		22	1	Electric Utilit	ST	BIT	COL	SOCO	M	short tons	200,575	6,066	
8	N	.	Gorgas	Alabama Pov	195	AL	ESC	SERC		22	1	Electric Utilit	ST	DFO	DFO	SOCO	M	barrels	1,877	297	
9	N	.	Copper	El Paso Elect	5701	TX	WSC	WECC		22	1	Electric Utilit	GT	DFO	DFO	EPE	A	barrels	0	0	
9	N	.	Copper	El Paso Elect	5701	TX	WSC	WECC		22	1	Electric Utilit	GT	NG	NG	EPE	A	mcf	51,534	41,429	
10	N	.	Greene Coun	Alabama Pov	195	AL	ESC	SERC		22	1	Electric Utilit	GT	DFO	DFO	SOCO	M	barrels	0	0	
10	N	.	Greene Coun	Alabama Pov	195	AL	ESC	SERC		22	1	Electric Utilit	GT	NG	NG	SOCO	M	mcf	6,140	12,365	
10	N	.	Greene Coun	Alabama Pov	195	AL	ESC	SERC		22	1	Electric Utilit	ST	NG	NG	SOCO	M	mcf	605,982	568,938	
11	N	.	H Neely Hen	Alabama Pov	195	AL	ESC	SERC		22	1	Electric Utilit	HY	WAT	HYC	SOCO	A		0	0	
12	N	.	Holt Dam	Alabama Pov	195	AL	ESC	SERC		22	1	Electric Utilit	HY	WAT	HYC	SOCO	A		0	0	
13	N	.	Jordan Dam	Alabama Pov	195	AL	ESC	SERC		22	1	Electric Utilit	HY	WAT	HYC	SOCO	A		0	0	
14	N	.	Logan Martir	Alabama Pov	195	AL	ESC	SERC		22	1	Electric Utilit	HY	WAT	HYC	SOCO	A		0	0	
15	N	.	Lay Dam	Alabama Pov	195	AL	ESC	SERC		22	1	Electric Utilit	HY	WAT	HYC	SOCO	A		0	0	
16	N	.	Martin Dam	Alabama Pov	195	AL	ESC	SERC		22	1	Electric Utilit	HY	WAT	HYC	SOCO	A		0	0	
17	N	.	Mitchell Dan	Alabama Pov	195	AL	ESC	SERC		22	1	Electric Utilit	HY	WAT	HYC	SOCO	A		0	0	
18	N	.	Lewis Smith	Alabama Pov	195	AL	ESC	SERC		22	1	Electric Utilit	HY	WAT	HYC	SOCO	A		0	0	
19	N	.	Thurlow Dan	Alabama Pov	195	AL	ESC	SERC		22	1	Electric Utilit	HY	WAT	HYC	SOCO	A		0	0	
20	N	.	Weiss Dam	Alabama Pov	195	AL	ESC	SERC		22	1	Electric Utilit	HY	WAT	HYC	SOCO	A		0	0	
21	N	.	Yates Dam	Alabama Pov	195	AL	ESC	SERC		22	1	Electric Utilit	HY	WAT	HYC	SOCO	A		0	0	
26	N	.	E C Gaston	Alabama Pov	195	AL	ESC	SERC		22	1	Electric Utilit	GT	DFO	DFO	SOCO	M	barrels	58	40	
26	N	.	E C Gaston	Alabama Pov	195	AL	ESC	SERC		22	1	Electric Utilit	ST	BIT	COL	SOCO	M	short tons	93,404	171,952	
26	N	.	E C Gaston	Alabama Pov	195	AL	ESC	SERC		22	1	Electric Utilit	ST	NG	NG	SOCO	M	mcf	569,821	361,161	
30	N	.	Madelia	City of Made	29305	MN	WNC	MRO		22	1	Electric Utilit	IC	DFO	DFO	MISO	A	barrels	6	19	
30	N	.	Madelia	City of Made	29305	MN	WNC	MRO		22	1	Electric Utilit	IC	NG	NG	MISO	A	mcf	0	0	
34	N	.	Rollins	Nevada Irrig	13402	CA	PACC	WECC		22	2	NAICS-22 No	HY	WAT	HYC	CISO	A		0	0	
38	N	.	Millers Ferry	USCE-Mobile	27813	AL	ESC	SERC		22	1	Electric Utilit	HY	WAT	HYC	SOCO	A		0	0	
46	N	2	Browns Ferr	Tennessee V	18642	AL	ESC	SERC		22	1	Electric Utilit	ST	NUC	NUC	TVA	M		0	0	

Data cleansing using MySQL

Data has 87 columns. First we need to drop all columns we don't need.

Columns we need: Plant Id, Plant Name, Operator Name, Operator Id, Plant State etc.

```
ALTER TABLE team_project.eia923_schedules_2_3_4_5_m_12_2019_final_revision
DROP COLUMN `Combined Heat And
Power Plant`,
DROP COLUMN `Nuclear Unit Id`,
DROP COLUMN `Census Region`,
DROP COLUMN `NERC Region`,
DROP COLUMN Reserved,
DROP COLUMN `NAICS Code`,
DROP COLUMN `EIA Sector Number`,
DROP COLUMN `Sector Name`,
…
DROP COLUMN `Elec_MMBtu November`,
DROP COLUMN `Elec_MMBtu December`,
DROP COLUMN `Total Fuel Consumption Quantity`,
DROP COLUMN `Electric Fuel Consumption Quantity`,
DROP COLUMN `Total Fuel Consumption MMBtu`,
DROP COLUMN `Elec Fuel Consumption MMBtu`,
DROP COLUMN YEAR;
```

Plant Id	Plant Name	Operator Name	Operator Id	Plant State	Reported Prime Mover	Netgen January	Netgen February	Netgen March	Netgen April	Netgen May	Netgen June	Netgen July	Netgen August	Netgen September	Netgen October	Netgen November	Netgen December	Net Generation (Megawatthou...
1	Sand Point	TDX Sand Point Generating, LLC	63560	AK	IC	196	217	216	198	216	185	211	234	277	292	221	295	2,758
1	Sand Point	TDX Sand Point Generating, LLC	63560	AK	WT	88	81	90	101	89	76	75	68	83	95	86	90	1,022
2	Bankhead Dam	Alabama Power Co	195	AL	HY	-24	-22	-26	-26	-32	-28	-24	-23	-18	-18	-21	-22	-284
3	Barry	Alabama Power Co	195	AL	CA	249,734	239,279	260,061	166,618	241,896	252,882	253,399	267,202	255,971	255,736	250,232	131,877	2,824,887
3	Barry	Alabama Power Co	195	AL	CT	469,654	449,491	487,355	313,253	460,403	475,069	476,259	500,818	476,004	472,701	471,065	254,319	5,306,391
3	Barry	Alabama Power Co	195	AL	ST	389,709	285,410	294,181	376,377	329,040	376,204	435,477	308,009	253,789	333,502	373,084	420,121	4,174,904
3	Barry	Alabama Power Co	195	AL	ST	10,565	4,502	14,144	1,904	26,587	7,294	20,596	8,790	38,867	10,241	18,985	2,151	164,625
3	Barry	Alabama Power Co	195	AL	ST	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Walter Bouldin Dam	Alabama Power Co	195	AL	HY	60,052	56,172	65,774	67,405	80,524	70,295	60,722	58,283	46,709	46,581	54,230	56,941	723,690
7	Gadsden	Alabama Power Co	195	AL	ST	13,131	11,972	13,250	16,936	15,347	10,074	15,321	15,126	14,625	15,199	14,264	14,732	169,977
9	Copper	El Paso Electric Co	5701	TX	GT	0	0	0	0	0	0	0	0	0	0	0	0	0
9	Copper	El Paso Electric Co	5701	TX	GT	3,062	2,462	2,645	2,384	3,242	3,741	4,304	4,634	4,005	3,106	2,817	3,132	39,534
10	Greene County	Alabama Power Co	195	AL	GT	0	0	0	0	0	0	0	0	0	89	15	0	104
10	Greene County	Alabama Power Co	195	AL	GT	95	703	606	1,550	4,832	3,210	5,820	5,149	13,985	4,824	2,669	63	43,506
10	Greene County	Alabama Power Co	195	AL	ST	57,498	53,429	67,477	106,508	177,086	187,701	232,911	225,192	196,890	185,328	108,789	125,470	1,724,279
11	H Neely Henry Dam	Alabama Power Co	195	AL	HY	20,885	19,535	22,874	23,442	28,004	24,447	21,117	20,269	16,244	16,200	18,860	19,803	251,681
12	Holt Dam	Alabama Power Co	195	AL	HY	14,083	13,173	15,424	15,807	18,884	16,485	14,240	13,668	10,954	10,924	12,717	13,353	169,711
13	Jordan Dam	Alabama Power Co	195	AL	HY	33,180	31,037	36,342	37,243	44,492	38,840	33,550	32,203	25,808	25,737	29,963	31,462	399,857
14	Logan Martin Dam	Alabama Power Co	195	AL	HY	37,013	34,621	40,539	41,545	49,631	43,326	37,425	35,922	28,789	28,710	33,424	35,095	446,040

The dataset has 19 columns.
The next step is to rename columns:

```
ALTER TABLE `team_project`.`eia923_schedules_2_3_4_5_m_12_2019_final_revision`
CHANGE COLUMN `Plant Id` `plant_id` INT NULL DEFAULT NULL ,
CHANGE COLUMN `Plant Name` `plant_name` TEXT NULL DEFAULT NULL ,
CHANGE COLUMN `Operator Name` `operator_name` TEXT NULL DEFAULT NULL ,
CHANGE COLUMN `Operator Id` `operator_id` INT NULL DEFAULT NULL ,
CHANGE COLUMN `Plant State` `plant_state` TEXT NULL DEFAULT NULL ,
CHANGE COLUMN `Reported Prime Mover` `reported_prime_mover` TEXT NULL DEFAULT NULL ,
CHANGE COLUMN `Netgen January` `jen_2019` TEXT NULL DEFAULT NULL ,
CHANGE COLUMN `Netgen February` `feb_2019` TEXT NULL DEFAULT NULL ,
CHANGE COLUMN `Netgen March` `mar_2019` TEXT NULL DEFAULT NULL ,
CHANGE COLUMN `Netgen April` `apr_2019` TEXT NULL DEFAULT NULL ,
CHANGE COLUMN `Netgen May` `may_2019` TEXT NULL DEFAULT NULL ,
CHANGE COLUMN `Netgen June` `jun_2019` TEXT NULL DEFAULT NULL ,
CHANGE COLUMN `Netgen July` `jul_2019` TEXT NULL DEFAULT NULL ,
CHANGE COLUMN `Netgen August` `aug_2019` TEXT NULL DEFAULT NULL ,
CHANGE COLUMN `Netgen September` `sep_2019` TEXT NULL DEFAULT NULL ,
CHANGE COLUMN `Netgen October` `oct_2019` TEXT NULL DEFAULT NULL ,
CHANGE COLUMN `Netgen November` `nov_2019` TEXT NULL DEFAULT NULL ,
CHANGE COLUMN `Netgen December` `dec_2019` TEXT NULL DEFAULT NULL ,
CHANGE COLUMN `Net Generation (Megawatthours)` `net_gen_2019` TEXT NULL DEFAULT NULL ;
```

	plant_id	plant_name	operator_name	operator_id	plant_state	reported_prime_mo...	jen_2019	feb_2019	mar_2019	apr_2019	may_2019	jun_2019	jul_2019	aug_2019	sep_2019	oct_2019	nov_2019	dec_2019	net_gen_2019
▶	1	Sand Point	TDX Sand Point Generating, LLC	63560	AK	IC	196	217	216	198	216	185	211	234	277	292	221	295	2,758
	1	Sand Point	TDX Sand Point Generating, LLC	63560	AK	WT	88	81	90	101	89	76	75	68	83	95	86	90	1,022
	2	Bankhead Dam	Alabama Power Co	195	AL	HY	-24	-22	-26	-26	-32	-28	-24	-23	-18	-18	-21	-22	-284
	3	Barry	Alabama Power Co	195	AL	CA	249,734	239,279	260,061	166,618	241,896	252,882	253,399	267,202	255,971	255,736	250,232	131,877	2,824,887
	3	Barry	Alabama Power Co	195	AL	CT	469,654	449,491	487,355	313,253	460,403	475,069	476,259	500,818	476,004	472,701	471,065	254,319	5,306,391
	3	Barry	Alabama Power Co	195	AL	ST	389,709	285,410	294,181	376,377	329,040	376,204	435,477	308,009	253,789	333,502	373,084	420,121	4,174,904
	3	Barry	Alabama Power Co	195	AL	ST	10,565	4,502	14,144	1,904	26,587	7,294	20,596	8,790	38,867	10,241	18,985	2,151	164,625
	3	Barry	Alabama Power Co	195	AL	ST	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	Walter Bouldin Dam	Alabama Power Co	195	AL	HY	60,052	56,172	65,774	67,405	80,524	70,295	60,722	58,283	46,709	46,581	54,230	56,941	723,690
	7	Gadsden	Alabama Power Co	195	AL	ST	13,131	11,972	13,250	16,936	15,347	10,074	15,321	15,126	14,625	15,199	14,264	14,732	169,977
	9	Copper	El Paso Electric Co	5701	TX	GT	0	0	0	0	0	0	0	0	0	0	0	0	0
	9	Copper	El Paso Electric Co	5701	TX	GT	3,062	2,462	2,645	2,384	3,242	3,741	4,304	4,634	4,005	3,106	2,817	3,132	39,534
	10	Greene County	Alabama Power Co	195	AL	GT	0	0	0	0	0	0	0	0	0	89	15	0	104
	10	Greene County	Alabama Power Co	195	AL	GT	95	703	606	1,550	4,832	3,210	5,820	5,149	13,985	4,824	2,669	63	43,506
	10	Greene County	Alabama Power Co	195	AL	ST	57,498	53,429	67,477	106,508	177,086	187,701	232,911	225,192	196,890	185,328	108,789	125,470	1,724,279
	11	H Neely Henry Dam	Alabama Power Co	195	AL	HY	20,885	19,535	22,874	23,442	28,004	24,447	21,117	20,269	16,244	16,200	18,860	19,803	251,681
	12	Holt Dam	Alabama Power Co	195	AL	HY	14,083	13,173	15,424	15,807	18,884	16,485	14,240	13,668	10,954	10,924	12,717	13,353	169,711
	13	Jordan Dam	Alabama Power Co	195	AL	HY	33,180	31,037	36,342	37,243	44,492	38,840	33,550	32,203	25,808	25,737	29,963	31,462	399,857
	14	Logan Martin Dam	Alabama Power Co	195	AL	HY	37,013	34,621	40,539	41,545	49,631	43,326	37,425	35,922	28,789	28,710	33,424	35,095	446,040

Data type of columns jan_2019, feb_2019, mar_2019 … net_gen_2019 is TEXT. Lets change the data type to INC:

```
ALTER TABLE `team_project`.`eia923_schedules_2_3_4_5_m_12_2019_final_revision`
CHANGE COLUMN `jen_2019` `jen_2019` INT NULL DEFAULT NULL ,
CHANGE COLUMN `feb_2019` `feb_2019` INT NULL DEFAULT NULL ,
CHANGE COLUMN `mar_2019` `mar_2019` INT NULL DEFAULT NULL ,
CHANGE COLUMN `apr_2019` `apr_2019` INT NULL DEFAULT NULL ,
CHANGE COLUMN `may_2019` `may_2019` INT NULL DEFAULT NULL ,
CHANGE COLUMN `jun_2019` `jun_2019` INT NULL DEFAULT NULL ,
CHANGE COLUMN `jul_2019` `jul_2019` INT NULL DEFAULT NULL ,
CHANGE COLUMN `aug_2019` `aug_2019` INT NULL DEFAULT NULL ,
CHANGE COLUMN `sep_2019` `sep_2019` INT NULL DEFAULT NULL ,
CHANGE COLUMN `oct_2019` `oct_2019` INT NULL DEFAULT NULL ,
CHANGE COLUMN `nov_2019` `nov_2019` INT NULL DEFAULT NULL ,
CHANGE COLUMN `dec_2019` `dec_2019` INT NULL DEFAULT NULL ,
CHANGE COLUMN `net_gen_2019` `net_gen_2019` INT NULL DEFAULT NULL ;
```

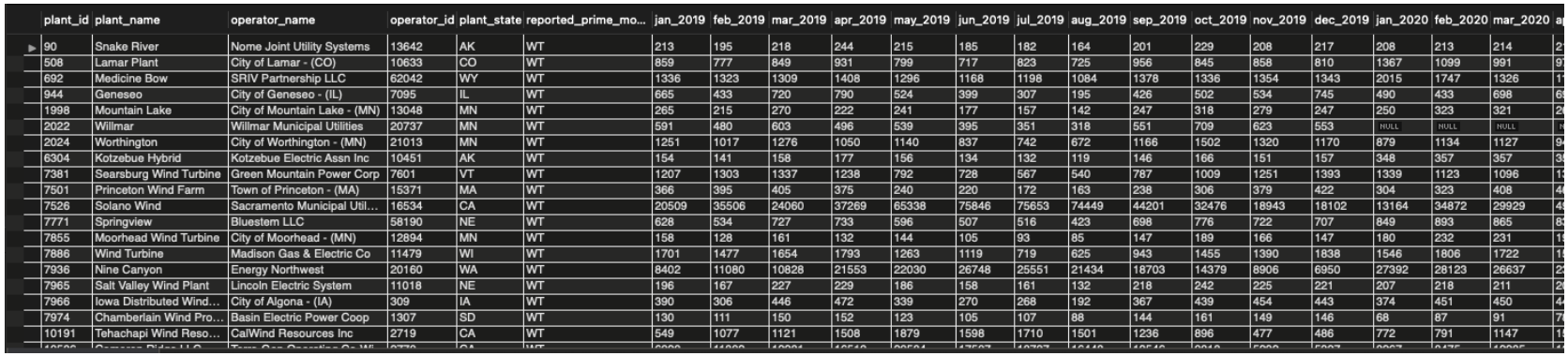
Column	Datatype
jan_2019	INT
feb_2019	INT
mar_2019	INT
apr_2019	INT
may_2019	INT
jun_2019	INT
jul_2019	INT
aug_2019	INT
sep_2019	INT
oct_2019	INT
nov_2019	INT
dec_2019	INT

The same way cleaning EIA923_Schedules_2_3_4_5_M_12_2020_Final_Revision.xlsx and EIA923_Schedules_2_3_4_5_M_12_2021_Early_Release.xlsx

Rename those datasets to wind_clear_2019.csv, wind_clear_2020.csv and wind_clear_2021.csv
Now the data is ready for analysis.

Join tree datasets:

```
SELECT a.plant_id, a.plant_name, a.operator_name, a.operator_id, a.plant_state, a.reported_prime_mover,
a.jan_2019, a.feb_2019, a.mar_2019,
a.apr_2019, a.may_2019, a.jun_2019,
a.jul_2019, a.aug_2019, a.sep_2019,
a.oct_2019, a.nov_2019, a.dec_2019,
b.jan_2020, b.feb_2020,
b.mar_2020, b.apr_2020, b.may_2020,
b.jun_2020, b.jul_2020, b.aug_2020,
b.sep_2020, b.oct_2020, b.nov_2020,
b.dec_2020, b.jan_2021, b.feb_2021,
b.mar_2021, b.apr_2021, b.may_2021,
b.jun_2021, b.jul_2021, b.aug_2021,
b.sep_2021, b.oct_2021, b.nov_2021,
b.dec_2021,  a.net_generation_megawatthours,
b.net_generation_megawatthours_2020, c.net_generation_megawatthours_2021
FROM team_project.wind_clear_2019 a
LEFT JOIN team_project.wind_clear_2020 b ON a.plant_id = b.plant_id
LEFT JOIN team_project.wind_clear_2021 c ON a.plant_id = c.plant_id;
```



plant_id	plant_name	operator_name	operator_id	plant_state	reported_prime_mo...	jan_2019	feb_2019	mar_2019	apr_2019	may_2019	jun_2019	jul_2019	aug_2019	sep_2019	oct_2019	nov_2019	dec_2019	jan_2020	feb_2020	mar_2020	a
90	Snake River	Nome Joint Utility Systems	13642	AK	WT	213	195	218	244	215	185	182	164	201	229	208	217	208	213	214	2
508	Lamar Plant	City of Lamar - (CO)	10633	CO	WT	859	777	849	931	799	717	823	725	956	845	858	810	1367	1099	991	9
692	Medicine Bow	SRIV Partnership LLC	62042	WY	WT	1336	1323	1309	1408	1296	1168	1198	1084	1378	1336	1354	1343	2015	1747	1326	1
944	Geneseo	City of Geneseo - (IL)	7095	IL	WT	665	433	720	790	524	399	307	195	426	502	534	745	490	433	698	6
1998	Mountain Lake	City of Mountain Lake - (MN)	13048	MN	WT	265	215	270	222	241	177	157	142	247	318	279	247	250	323	321	2
2022	Willmar	Willmar Municipal Utilities	20737	MN	WT	591	480	603	496	539	395	351	318	551	709	623	553	NULL	NULL	NULL	7
2024	Worthington	City of Worthington - (MN)	21013	MN	WT	1251	1017	1276	1050	1140	837	742	672	1166	1502	1320	1170	879	1134	1127	9
6304	Kotzebue Hybrid	Kotzebue Electric Assn Inc	10451	AK	WT	154	141	158	177	156	134	132	119	146	166	151	157	348	357	357	3
7381	Searsburg Wind Turbine	Green Mountain Power Corp	7601	VT	WT	1207	1303	1337	1238	792	728	567	540	787	1009	1251	1393	1339	1123	1096	1
7501	Princeton Wind Farm	Town of Princeton - (MA)	15371	MA	WT	366	395	405	375	240	220	172	163	238	306	379	422	304	323	408	4
7526	Solano Wind	Sacramento Municipal Util...	16534	CA	WT	20509	35506	24060	37269	65338	75846	75653	74449	44201	32476	18943	18102	13164	34872	29929	4
7771	Springview	Bluestem LLC	58190	NE	WT	628	534	727	733	596	507	516	423	698	776	722	707	849	893	865	8
7855	Moorhead Wind Turbine	City of Moorhead - (MN)	12894	MN	WT	158	128	161	132	144	105	93	85	147	189	166	147	180	232	231	1
7886	Wind Turbine	Madison Gas & Electric Co	11479	WI	WT	1701	1477	1654	1793	1263	1119	719	625	943	1455	1390	1838	1546	1806	1722	1
7936	Nine Canyon	Energy Northwest	20160	WA	WT	8402	11080	10828	21553	22030	26748	25551	21434	18703	14379	8906	6950	27392	28123	26637	2
7965	Salt Valley Wind Plant	Lincoln Electric System	11018	NE	WT	196	167	227	229	186	158	161	132	218	242	225	221	207	218	211	2
7966	Iowa Distributed Wind...	City of Algona - (IA)	309	IA	WT	390	306	446	472	339	270	268	192	367	439	454	443	374	451	450	4
7974	Chamberlain Wind Pro...	Basin Electric Power Coop	1307	SD	WT	130	111	150	152	123	105	107	88	144	161	149	146	68	87	91	7
10191	Tehachapi Wind Reso...	CalWind Resources Inc	2719	CA	WT	549	1077	1121	1508	1879	1598	1710	1501	1236	896	477	486	772	791	1147	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Save the dataset as wind_2019_20_21.csv
For project purposes looking Top 10 operators and SUM generated energy:

```
SELECT operator_name,SUM(net_generation_megawatthours) AS sum_gen_2019, SUM(net_generation_megawatthours_2020) AS
sum_gen_2020, SUM(net_generation_megawatthours_2021) AS sum_gen_2021
FROM team_project.wind_2019_20_21
GROUP BY operator_name
ORDER BY 4 DESC
LIMIT 10;
```

operator_name	sum_gen_2019	sum_gen_2020	sum_gen_2021
MidAmerican Energy Co	15893714	20368198	22473080
Avangrid Renewables LLC	15930818	18266702	17399584
EDF Renewable Asset Holdings, Inc.	13300307	14409484	14396619
RWE Renewables Americas LLC	12259939	12017644	12268700
Invenergy Services LLC	8761988	10268820	10206143
State-Fuel Level Increment	106210	87178	8181179
Pattern Operators LP	7099417	6735523	7582182
Southern Power Co	6263424	6747633	7520447
Engie North America	NULL	2140447	6433581
PacifiCorp	2112892	3587629	5517511

Using main dataset to find number of turbines each company operating.

FROM team_project.`turbine amount`;

eia_id	t_state	t_county	t_fips	p_name	p_year	p_tnum
90	AK	Nome Census Area	2180	Nome	2008	18
90	AK	Nome Census Area	2180	Nome Newton Peak	2013	2
508	CO	Baca County	8009	Lamar III	2004	2
508	CO	Prowers County	8099	Lamar Municipal	2004	3
692	WY	Carbon County	56007	Medicine Bow	1998	2
692	WY	Carbon County	56007	Medicine Bow	1999	5
692	WY	Carbon County	56007	Medicine Bow	2000	2

For project purposes join wind_2019_20_21.csv and ‘turbine amount.csv’ to find numbers of turbines belong to each operator.

```
SELECT a.plant_id, a.operator_name, a.plant_name, a.plant_state, SUM(b.p_tnum) AS total_turbine,
SUM(net_generation_megawatthours) AS get_2019,
 SUM(net_generation_megawatthours_2020)AS gen_2020, SUM(net_generation_megawatthours_2021) AS gen_2021
FROM team_project.wind_2019_20_21 a
LEFT JOIN team_project.`turbine amount` b ON a.plant_id = b.eia_id
WHERE operator_name LIKE '%MidAmerica%'
GROUP BY a.plant_id, a.operator_name, a.plant_name, a.plant_state;
```

plant_id	operator_name	plant_name	plant_state	total_turbi...	get_2019	gen_2020	gen_2021
56251	MidAmerican Energy Co	Intrepid	IA	244	1952640	2078372	2108716
56252	MidAmerican Energy Co	Century	IA	253	3217734	3420126	3422280
56379	MidAmerican Energy Co	Victory Wind Farm	IA	132	689996	708770	768172
56501	MidAmerican Energy Co	Pomeroy Wind Farm	IA	196	3572250	4586075	4701495
56677	MidAmerican Energy Co	Charles City Wind Farm	IA	50	236902	246973	254715
56809	MidAmerican Energy Co	Carroll Wind Farm	IA	100	402551	520089	545276
56810	MidAmerican Energy Co	Adair Wind Farm	IA	152	786064	975530	988860
56811	MidAmerican Energy Co	Walnut Wind Farm	IA	102	403583	542072	532182
57500	MidAmerican Energy Co	Laurel Wind Farm	IA	52	340360	343276	360530
57501	MidAmerican Energy Co	Rolling Hills Wind Farm	IA	579	3521133	3658119	3285888
57873	MidAmerican Energy Co	Eclipse Wind Farm	IA	174	1266800	1353110	1361848
57874	MidAmerican Energy Co	Vienna Wind Farm	IA	109	1154415	1393194	1466562
57875	MidAmerican Energy Co	Morning Light Wind Fa...	IA	44	304932	327779	323577
58883	MidAmerican Energy Co	Highland Wind Project...	IA	214	2922144	3036874	3214342
58884	MidAmerican Energy Co	Lundgren Wind Project	IA	107	720872	797900	824480
58885	MidAmerican Energy Co	Macksburg Wind Project	IA	51	336094	320713	306103
58886	MidAmerican Energy Co	Wellsburg Wind Project	IA	60	403277	431761	473983
59637	MidAmerican Energy Co	Adams Wind	IA	64	457394	421448	392172
60326	MidAmerican Energy Co	O'Brien Wind	IA	104	750527	803319	821996