Gas Turbine Starts/Stops, USA

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Forward

This Study

An original virtue of gas turbine technology as a source of power generation was its capability to turn on and off (start/stop) quickly and efficiently. Grid operators deployed this feature to smooth seasonal and daily fluctuations in demand without disturbing other technologies best operated at baseload like hydro, nuclear and fossil.

As power generation evolves and supply intermittency from wind and solar generation increases, the challenge to grid operators to maintain stability will only increase. Grids may require more gas turbine starts/stops, or they may benefit from other more recent innovations like batteries that shift load peaks, large reciprocating engines that can also start/stop, and more flexible turn down capabilities among existing technologies.

This report provides a top down view of gas turbine starts/stops for units of at least 20 MWe at USA based power plants. We present gross number of starts/stops over time; our primary mode of inquiry is by turbine class (Aero, F Class and E Class) and by cycle (simple and combined cycle). Our source data sets are McCoy Power Reports, the EPA, and the EIA. Of the 3,233 gas turbines for which we present performance data within this report, 2,507 are mapped to gas turbine models. Our data yields the following proxies for starts/stops: (i) when a unit fires for less than a full hour and (ii) full operating hours preceded or followed by zero operating hours. This method affords a rich context of valid interpretation.

The practical applications of this report are obvious: which units, geographies, cycles and models are the most active. Less obvious is the meaning of these trends, the impacts on the health and well being of our grids, and the general fortunes of the gas turbine industry. Other questions and issues or yet undiscovered, but for now, let us embark upon this journey of discernment and periodically return to this narrative to measure progress and to pose new questions.

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In addition to this report, we offer individual gas turbine starts/stops performance data, a sample of which is contained below. The data contains (at the unit level) annual operating time, annual gross load, annual steam load, average monthly starts/stops, actual monthly starts/stops, facility name, operator, owner, type of cycle, and model. We offer five years of data for the entire fleet in excel format.

FACILITY	OPERATOR	OWNER	STATE	SIMPFANY UNIT ID	TYPE OF UNIT	MODEL	YEAR	ANNUAL OPERATING TIME	ANNUAL GROSS LOAD	AVGE MONTHLY STARTS/STOPS
Mustang	Oklahoma Gas & Electric Company	Oklahoma Gas & Electric Company	OK	3416	SIMPLE CYCLE	TRENT 60	2019	3,909	195,056	60
Mustang	Oklahoma Gas & Electric Company	Oklahoma Gas & Electric Company	OK	5793	SIMPLE CYCLE	TRENT 60	2019	3,677	182,544	60
Mustang	Oklahoma Gas & Electric Company	Oklahoma Gas & Electric Company	OK	7008	SIMPLE CYCLE	TRENT 60	2019	3,624	176,940	59
Cabrillo Power I Encina Power Station	Carlsbad Energy Center LLC	Carlsbad Energy Center LLC	CA	8008	SIMPLE CYCLE	LMS 100	2019	1,605	82,107	65
Cabrillo Power I Encina Power Station	Carlsbad Energy Center LLC	Carlsbad Energy Center LLC	CA	8009	SIMPLE CYCLE	LMS 100	2019	1,602	82,055	63
Cabrillo Power I Encina Power Station	Carlsbad Energy Center LLC	Carlsbad Energy Center LLC	CA	8010	SIMPLE CYCLE	LMS 100	2019	1,605	83,061	65
Cabrillo Power I Encina Power Station	Carlsbad Energy Center LLC	Carlsbad Energy Center LLC	CA	8011	SIMPLE CYCLE	LMS 100	2019	1,670	86,542	65
Cabrillo Power I Encina Power Station	Carlsbad Energy Center LLC	Carlsbad Energy Center LLC	CA	8007	SIMPLE CYCLE	LMS 100	2019	1,268	63,974	65
Bayonne Energy Center	Bayonne Energy Center, LLC	Bayonne Energy Center, LLC	NJ	4543	SIMPLE CYCLE	TRENT 60	2019	1,331	68,395	61
Bayonne Energy Center	Bayonne Energy Center, LLC	Bayonne Energy Center, LLC	NJ	592	SIMPLE CYCLE	TRENT 60	2019	1,506	78,562	66
Bayonne Energy Center	Bayonne Energy Center, LLC	Bayonne Energy Center, LLC	NJ	3487	SIMPLE CYCLE	TRENT 60	2019	1,484	77,500	72
Bayonne Energy Center	Bayonne Energy Center, LLC	Bayonne Energy Center, LLC	NJ	7037	SIMPLE CYCLE	TRENT 60	2019	1,769	94,455	77
Bayonne Energy Center	Bayonne Energy Center, LLC	Bayonne Energy Center, LLC	NJ	7028	SIMPLE CYCLE	TRENT 60	2019	1,294	66,210	62
Pioneer Generating Station	Basin Electric Power Cooperative	Basin Electric Power Cooperative	ND	2945	SIMPLE CYCLE	LM6000	2019	3,012	94,090	63
Pioneer Generating Station	Basin Electric Power Cooperative	Basin Electric Power Cooperative	ND	614	SIMPLE CYCLE	LM6000	2019	3,019	94,171	61
Orange Cogeneration Facility	Northern Star Generation Services Company LLC	Orange Cogeneration Limited Partnership	FL	5980	COMB CYCLE	LM6000	2019	4,133	197,807	87
Orange Cogeneration Facility	Northern Star Generation Services Company LLC	Orange Cogeneration Limited Partnership	FL	4544	COMB CYCLE	LM6000	2019	4,385	221,402	61
Mulberry Cogeneration Facility	Northern Star Generation Services Company LLC	Polk Power Partners, LP	FL	3553	COMB CYCLE	7E.03	2019	3,882	435,561	80
Panoche Energy Center	Panoche Energy Center, LLC	Panoche Energy Center, LLC	CA	5836	SIMPLE CYCLE	LMS 100	2019	1,885	178,949	61
Panoche Energy Center	Panoche Energy Center, LLC	Panoche Energy Center, LLC	CA	4608	SIMPLE CYCLE	LMS 100	2019	1,851	176,230	60

For this image, gas turbine units of 20 MWe unit capacity and up. Sources: EIA, McCoy Power Reports and EPA. Images courtesy of Simpfany. Detailed, unit level performance data available via subscription.

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Introduction

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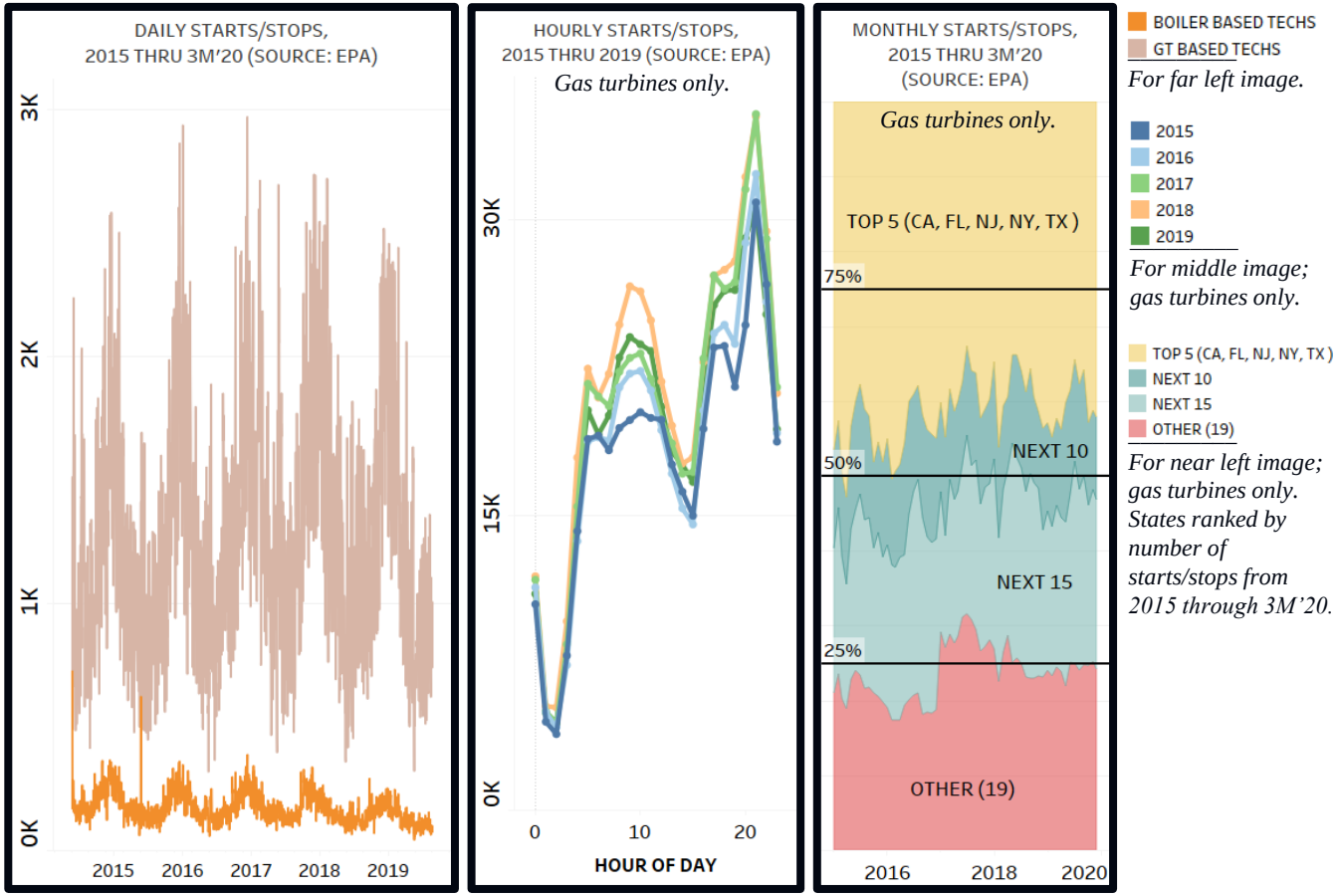
The image below left shows the number of starts/stops since 2015 for both gas turbines and boiler technologies of at least 20 MWe unit capacity. Though gas turbines outnumber boilers 2:1, gas turbines accounted for 7.5x the starts/stops of boilers from 2015 through 3M'20. Gas turbine starts/stops are most prevalent during the late morning and evening hours of the day (image below middle), and since 2015, the curve appears to be steepening from lows to highs. The top five states of California, Florida, New Jersey, New York and Texas hosted the most start/stop activity since the beginning of 2015 (image below right).



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Description of Simpfany

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USA and Europe Power Gen Fleet Analytics

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Est. 2016

- About Simpfany
  - Gathers and presents the operating statistics of power plant fleets wherever and however the data is made available
  - Currently, Simpfany presents data on USA and Europe based power plants and expects to add coverage as global trends favor increasing transparency; countries like India and China offer varying degrees of operating statistics on their fleets which Simpfany will work towards packaging and presenting in the near future
- Fleet Analytics:
  - From the individual performance of a single reciprocating engine, wind turbine plant or gas turbine to the emissions of a coal plant, thermal efficiency of an entire gas turbine fleet, or a specific type of fuel usage, Simpfany offers a trove of statistics
  - A wide range of performance evaluations are available across all power gen technologies, providing a platform of power gen investigation and inquiry
  - See what's possible

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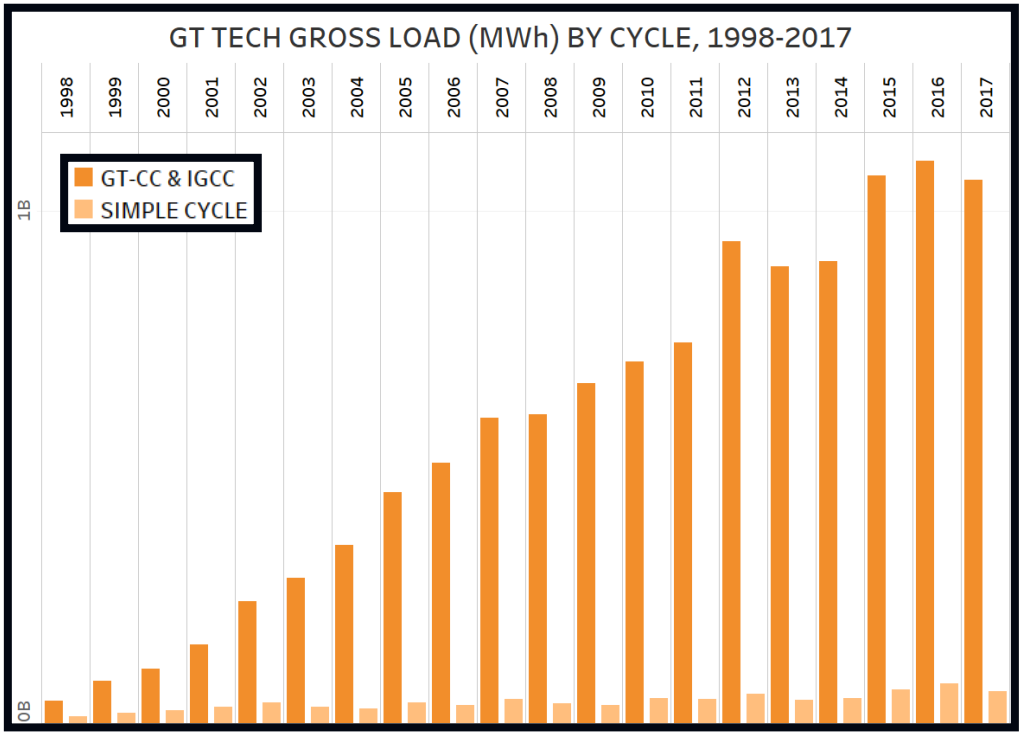
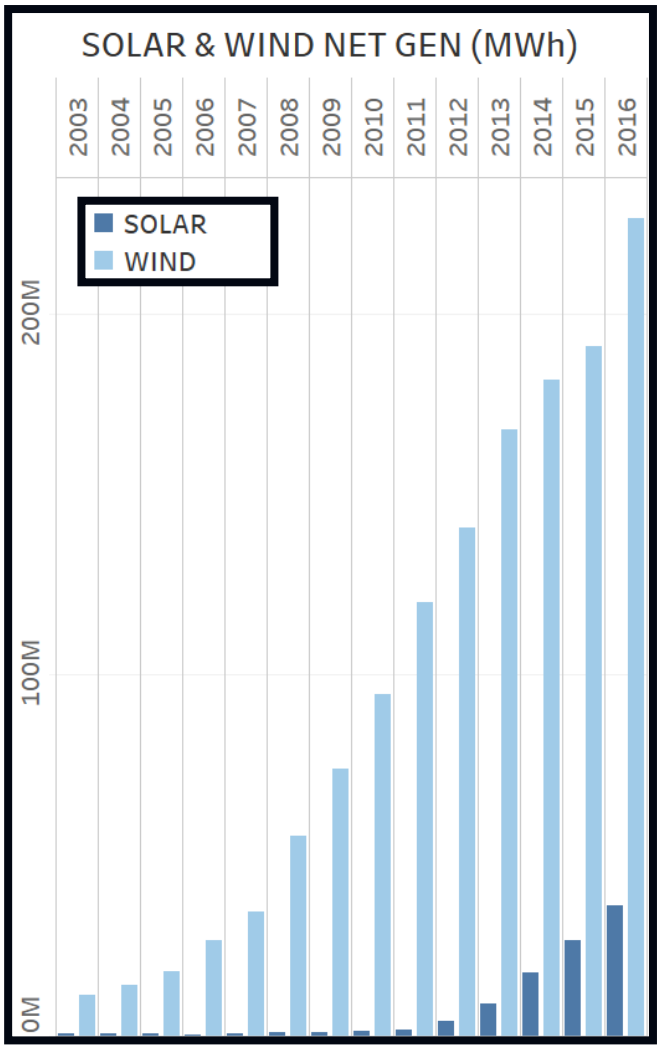
Description of Simpfany

Simpfany is a window on the USA's power generation Fleet, bringing transparency to grid operations. The utilization rates of various Technologies and the performance characteristics of those Technologies including capacity factors, thermal efficiencies, emission profiles can all be divined and investigated down to the individual unit level. These visualizations show utilization rates for the Technologies presented.





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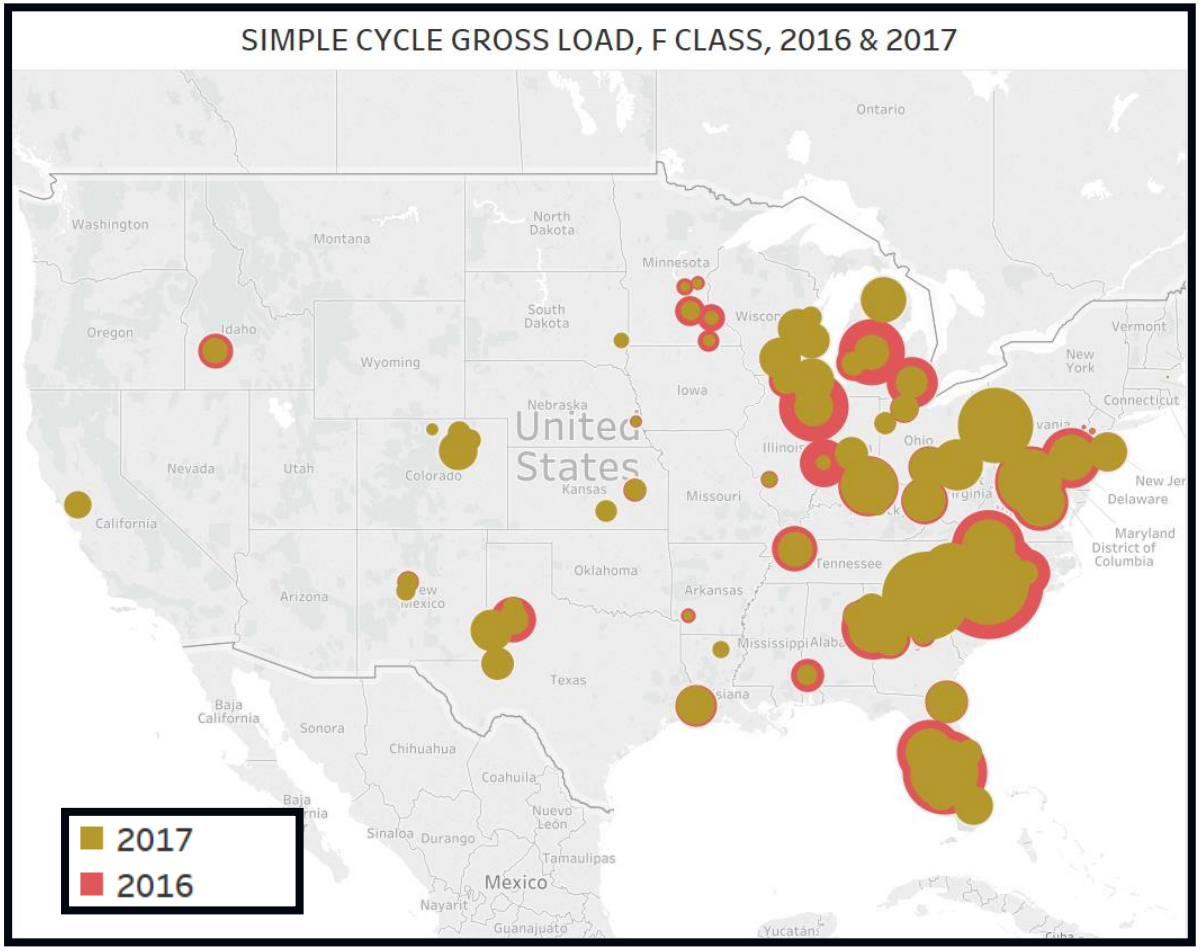
Description of Simpfany

Simpfany also contains mapping technology to enrich observations, especially those illuminating entire fleet characteristics. This visualization presents the Gross Load derived Gas Turbines of F Class Technology that operate in Simple Cycle during 2016 and 2017. The Gross Load for this Fleet declined 23% from 2016 to 2017, and as you can see, some regions were effected by the decline more than others.



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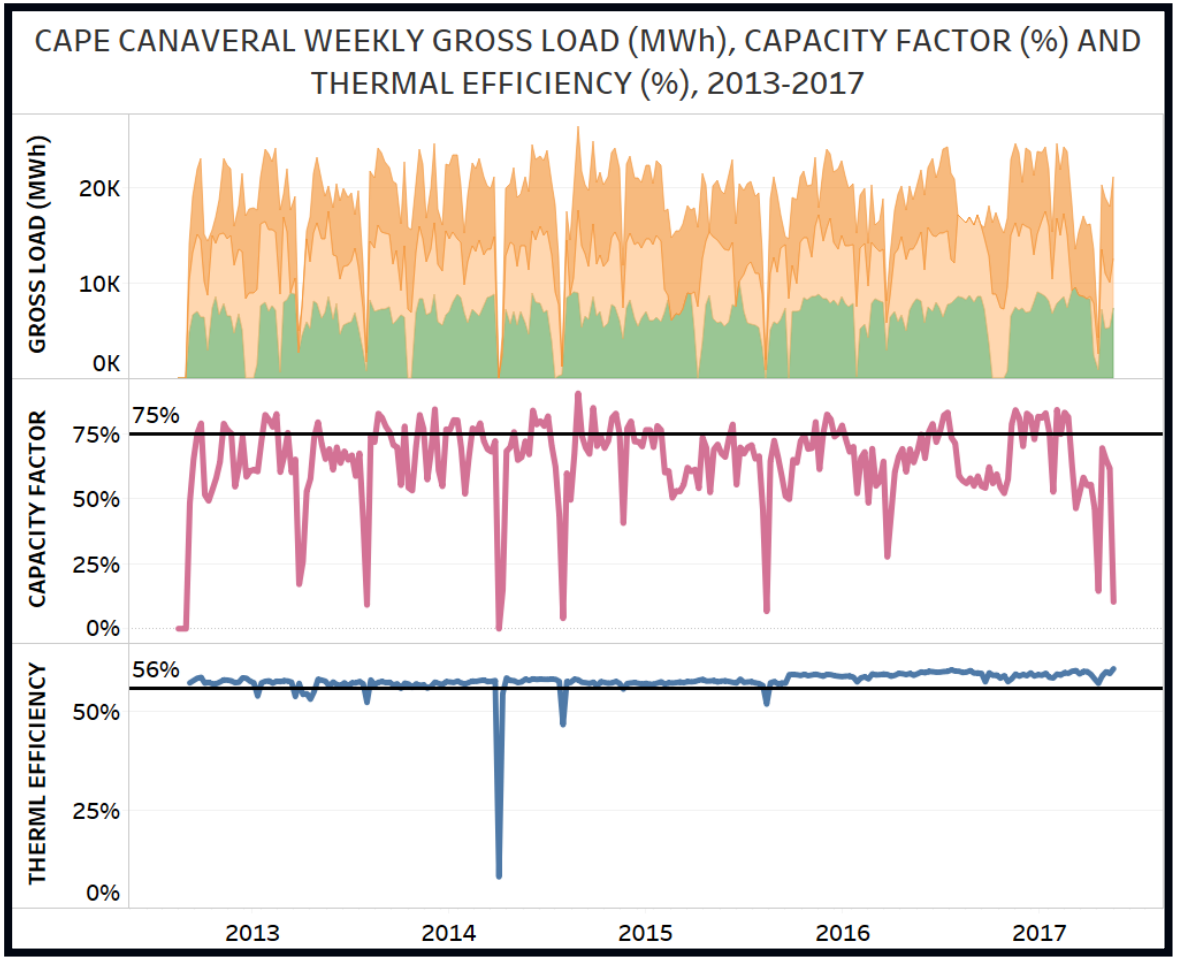
Description of Simpfany

In addition to macro trends effecting entire classes of Technologies, Simpfany enables detailed analysis of each power generation unit that operates in the USA and Europe (given certain capacity minimums). This visualization presents the Gross Load, Capacity Factor, and Effective Thermal Efficiency measured at daily intervals for the three GT units operating at Cape Canaveral in Florida, a 3x1 Combined Cycle power plant that features Siemens' H Class Technology.



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Description of Simpfany

Simpfany is offered to its clients through a data visualization portal called Tableau. Work can be saved in the Tableau environment and shared among colleagues; visualizations can be downloaded and put into presentations. Ask about our user groups.

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