2012 Operating Performance

Natural Gas Continues to Displace Coal

by Teresa Hansen, editor in chief

The 2012 power plant operating performance report reveals the continuation of a trend: Coal-fired capacity is losing out to natural gas. Last year *Electric Light & Power* reported that the total amount of electricity generated by all Energy Information Administration (EIA)-reporting coal-fired plants dropped some 4 percent from 2010 to 2011. That number was roughly 13 percent from 2011 to 2012, dropping the amount of electricity generated by all reporting coal-fired plants to just more than 1.5 million GWh. This decrease in coal-fired plant generation is the result of plants' being retired because they can't afford to meet environmental regulations and because many coal-fired plants are falling behind gas-fired plants on the dispatch list. Gas-fired combined-cycle plants that burn cheap natural gas are displacing coal-fired plants.

"Coal displacement is a big story. The coal plants on the 2012 top operating lists aren't the ones being displaced, but many of the little guys are falling by the wayside," said Tom Hewson, principal at Arlington, Va.,-based Energy Ventures Analysis Inc. "All the low-cost solutions for reducing coal-fired emissions have been implemented. The only low-cost solution left is fuel switching. The country, therefore, lost a lot of coal generation due to displacement by natural gas."

Last year's power plant performance report revealed that gas-fired combined-cycle plants generated more electricity in 2011 than 2010, and this year's report shows that trend is growing. The total amount of electricity generated by all EIA-reporting gas-fired combined-cycle power plants rose 24 percent from 2011 to 2012 to 972,131 GWh.

"The rise in natural gas generation is not because of load growth or higher demand for electricity," Hewson said. "It is due to displacement of coal."

Energy Ventures Analysis specializes in energy and environmental market analysis and has compiled the data for this industry report from Form EIA 906 "Power Plant Report" form for many years. The tables in this report are mostly self-explanatory, but a few observations follow.

Ameren Corp.'s Callaway Nuclear Generating Station near Fulton, Mo., had a capacity factor of 100.4 percent, putting it at the top of the U.S. nuclear power plant capacity factor ranking. Photo Courtesy Ameren Corp.

Coal-fired Power Plant Performance

Coal Generation: Table 1

This list is always made of coal plants with multiple large units.

"With no exceptions, units (on this list) are dispatched early because of their low variable costs," Hewson said. "Some plants that are usually on the list, however, have been displaced because of low natural gas prices."

Many of the plants displaced by natural gas are burning eastern coals, which are higher-priced than western and Powder River Basin (PRB) coals.

Eight plants fell off the top 20 coal-fired generation list from 2011 to 2012. Southern Co.'s 3,200-MW Bowen plant is most notable. Bowen has been in the top 20 for many years. It was No. 1 in 2009 and No. 13 in 2010. This year it fell to No. 44.

"Bowen is a large unit with all the emissions controls installed," Hewson said. "The fact that it is being displaced says more about the plants that are displacing it rather than Bowen itself. It will be back on the list when gas prices go up and as

Table 1: Top 20 Coal Ranked by Generation (2012)

Rank	Owner/Operator	Plant	State	Capacity MW	Generation (GWh)	Capacity Factor	Fuel Consumption mmBtu	Heat Rate (mmBtu/MWh)	2011 Rank
1	Southern Co.	Scherer	GA	3,407	19,982	66.8%	207,115,345	10.37	1
2	AEP	Rockport	IN	2,600	18,762	82.2%	183,340,624	9.77	11
3	Duke Energy Corp.	Gibson	IN	3,132	18,613	67.7%	191,682,554	10.30	7
4	FirstEnergy Generation Corp.	Bruce Mansfield	PA	2,510	17,806	80.8%	175,986,770	9.88	5
5	Southern Co.	Miller	AL	2,675	17,356	73.9%	180,523,803	10.40	2
6	AEP	Gen J M Gavin	OH	2,598	17,199	75.4%	170,311,603	9.90	4
7	Salt River Project	Navajo	AZ	2,250	15,876	80.3%	159,428,463	10.04	8
8	DTE Energy Co.	Monroe	MI	2,930	15,503	60.2%	158,803,590	10.24	9
9	Ameren Corp.	Labadie	MO	2,412	15,337	72.4%	156,911,188	10.23	3
10	Luminant	Martin Lake	TX	2,410	14,739	69.6%	166,719,165	11.31	6
11	TVA	Paradise	KY	2,201	14,651	75.8%	150,150,593	10.25	
12	TVA	Cumberland	TN	2,470	14,389	66.3%	145,108,200	10.08	
13	Duke Energy Corp.	Belews Creek	NC	2,220	13,974	71.7%	128,312,004	9.18	12
14	Duke Energy Corp.	Roxboro	NC	2,432	13,943	65.3%	145,500,310	10.44	
15	Pinnacle West Capital Corp.	Four Corners	NM	2,100	13,687	74.2%	140,508,995	10.27	16
16	MidAmerican Energy	Jim Bridger	WY	2,111	13,617	73.4%	140,358,801	10.31	
17	NRG Energy Inc.	W A Parish	TX	2,499	13,366	60.9%	141,523,664	10.59	10
18	Santee Cooper	Cross	SC	2,330	13,048	63.8%	127,229,496	9.75	15
19	AEP	John E Amos	WV	2,900	12,915	50.7%	126,615,281	9.80	14
20	Dynegy Inc.	Baldwin	IL	1,775	12,269	78.7%	125,743,812	10.25	20
				Total	Total	Average	Total	Average	
		Top 20 Generating		49,962	307,031	70.0%	3,121,874,261	10.17	
		EIA Reporting		307,385	1,496,986	55.4%	15,679,184,530	11.51	

other coal units are retired."

Coalstrip, another large unit that usually makes the list, dropped off in 2012—but just barely. It is No. 21.

Those plants that cannot or choose not to comply with Mercury and Air Toxics Standards (MATS) will be retired, and some units that have been on the list will come back, Hewson said. Most on the 2012 top 20 list already comply with MATS.

"Few coal plants are under construction or in advanced development, so we're likely to see only a few changes in this annual list," Hewson said.

The top 20 coal plants ranked by generation produced almost 21,000 GWh, or 6.3 percent, less electricity in

2012 than they did in 2011.

Coal Capacity Factor: Table 2

Overall coal-fired capacity factors were down significantly in 2012 because of natural gas displacements. The top 20 capacity factor threshold in 2012 was only 87 percent compared with 91.7 percent in 2011.

To get on the top 20 coal capacity factor list, Hewson said, a unit needs to fall into one of two categories:

1. Co-generation unit with steam sales contracts that require high utilizations; or
2. Unit tied to a contract with a facility that needs a lot of electricity around the clock, such as Sandow No. 5 that supplies power to an aluminum facility.

It also helps to be located in the West near the coal seam or even at the mine mouth, Hewson said.

In 2011, six plants dropped off the list and were replaced. The new additions were western coal plants that burn coal that is more cost-competitive with natural gas than eastern coals.

Coal-fired Heat Rate: Table 3

Qualifying coal heat rate for the top 20 plants was just slightly higher in 2012 than 2011: 9.874 mmBtu/MWh vs. 9.754 mmBtu/MWh. Because some coal-fired plants were displaced by natural gas in 2011, the heat rate for the entire reporting fleet of coal-fired plants was significantly higher: 11.51 mmBtu/MWh in 2012 vs. 10.45 mmBtu/MWh in 2011.

"Overall, coal units become less efficient and heat rates rise as unit utilization drops," Hewson said. "In addition, as the lower-heat rate plants are retired, the heat rate of all reporting plants will continue to go up."

Hewson said boiler heat rate is a function of three things:

1. **Boiler design.** Ultra-supercritical, supercritical or subcritical steam cycles.
2. **Fuel quality.** Eastern coal is dryer than PRB

Table 2: Top 20 Coal Ranked by Capacity Factor (2012)

Rank	Owner/Operator	Plant	State	Capacity MW	Generation (GWh)	Capacity Factor	Fuel Consumption mmBtu	Heat Rate (mmBtu/MWh)	2011 Rank
1	Black Hills Corp.	Wygen 1	WY	70	684	111.2%	8,027,587	11.74	1
2	Suez	Coleto Creek	TX	592	5,363	103.1%	52,958,866	9.87	
3	Yellowstone Electric Co.	Yellowstone	MT	52	454	99.4%	4,993,880	11.00	5
4	Colstrip Energy LP	Colstrip Energy	MT	35	301	97.9%	4,134,255	13.73	
5	The Babcock & Wilcox Co.	Ebensburg	PA	50	430	97.8%	6,134,102	14.27	2
6	Black Hills Corp.	Wygen III	WY	100	854	97.2%	9,688,378	11.35	11
7	Waste Management Inc.	Wheelabrator Frackville	PA	43	357	95.7%	2,578,016	7.21	3
8	Edison International	Grant Town	WV	80	661	94.0%	8,605,866	13.03	12
9	Black Hills Corp.	Neil Simpson	WY	19	153	93.9%	2,177,226	14.20	4
10	Exelon Corp.	Sunnyside Cogen	UT	51	418	93.2%	5,082,648	12.17	9
11	Energy Investors Funds	Morgantown	WV	50	408	93.0%	5,922,625	14.50	15
12	Colmac	Piney Creek	PA	33	265	92.8%	3,394,050	12.81	20
13	Rich Family Cos.	St Nicholas Cogen	PA	87	704	92.7%	11,282,081	16.02	16
14	Basin Electric Power	Dry Fork Station	WY	380	3,089	92.5%	31,542,259	10.21	
15	Great River Energy	Coal Creek	ND	1,138	9,224	92.3%	97,016,350	10.52	
16	Energy Investors Funds	Scrubgrass	PA	84	682	92.1%	9,037,458	13.25	17
17	UBS	Colver Power Project	PA	110	877	90.7%	9,196,995	10.49	18
18	Exelon Corp.	Panther Creek	PA	83	660	90.5%	9,180,952	13.91	7
19	Luminant	Sandow No. 5	TX	570	4,373	87.3%	48,417,468	11.07	
20	Black Hills Corp.	Wygen 2	WY	85	650	87.0%	7,759,861	11.94	
				Total	Total	Average	Total	Average	
		Top 20 Capacity Factors		3,711	30,607	94.7%	337,130,923	12.17	
		EIA Reporting		307,385	1,496,986	55.4%	15,679,184,530	11.51	

Table 3: Top 20 Coal Ranked by Heat Rate (2012)*

Rank	Owner/Operator	Plant	State	Capacity MW	Generation (GWh)	Capacity Factor	Fuel Consumption mmBtu	Heat Rate (mmBtu/MWh)	2011 Rank
1	First Reserve Corp.	Longview	WV	700	4,139	67.3%	37,218,602	8.992	1
2	Duke Energy Corp.	Belews Creek	NC	2,220	13,974	71.7%	128,312,004	9.182	4
3	TVA	Bull Run	TN	870	1,923	25.2%	17,815,870	9.265	5
4	SCANA Corp.	Cope	SC	415	1,984	54.4%	18,681,188	9.417	6
5	Great Plains Energy	Iatan	MO	1,586	11,810	84.8%	111,440,793	9.436	14
6	Xcel Energy Inc.	King	MN	511	3,358	74.8%	32,084,966	9.555	11
7	Duke Energy Corp.	Marshall	NC	2,078	9,597	52.6%	92,087,781	9.595	8
8	NRG Energy Inc.	Keystone	PA	1,700	9,496	63.6%	91,439,536	9.630	12
9	GenOn Energy	Avon Lake	OH	710	2,635	42.2%	25,516,400	9.685	
10	SCANA Corp.	Williams	SC	605	3,713	69.9%	36,074,560	9.715	13
11	NRG Energy Inc.	Conemaugh	PA	1,700	10,614	71.1%	103,351,389	9.737	
12	Omaha Public Power District	Nebraska City	NE	1,336	9,563	81.5%	93,220,653	9.748	
13	Santee Cooper	Cross	SC	2,330	13,048	63.8%	127,229,496	9.751	15
14	Integrys Energy Group Inc.	Weston	WI	1,004	4,929	55.9%	48,103,782	9.759	
15	CPS Energy	J K Spruce	TX	1,340	9,319	79.2%	91,031,196	9.769	10
16	AEP	Rockport	IN	2,600	18,762	82.2%	183,340,624	9.772	
17	AEP	John E Amos	WV	2,900	12,915	50.7%	126,615,281	9.803	
18	Xcel Energy Inc.	Valmont	CO	184	1,006	62.2%	9,915,566	9.861	
19	GenOn Energy	Morgantown	MD	1,205	5,209	49.2%	51,398,666	9.867	16
20	Suez	Coleto Creek	TX	592	5,363	103.1%	52,958,866	9.874	
				Total	Total	Average	Total	Average	
		Top 20 Heat Rate		26,587	153,357	65.3%	1,477,837,219	9.62	
*Excludes co-generating facilities		EIA Reporting		307,385	1,496,986	55.4%	15,679,184,530	11.51	

coal, so it burns more efficiently. The Btu value of eastern coal is about 12,000 Btu/lb. The Btu value of PRB and other western coal is typically 8,400 to 8,800 Btu/lb. This difference is mostly a result of moisture.

3. **Plant utilization.** Plants in high-utilization areas can operate at their optimum levels for long periods.

There was a lot of turnover on the top 20 heat rate list from 2011 to 2012. Eight fell off the list, including four of the top 10.

"Some fairly efficient plants didn't make the list this year," Hewson said.

The only ultra-supercritical plant that operated all 12 months of 2012, Longview, holds the No. 1 position. Most other plants on the top 20 list are supercritical plants, but a few subcritical units made the list, too, which is hard to do, Hewson said.

In addition, some PRB plants, Iatan, King, Nebraska City, Weston, JK Spruce and Rockport, made the top 20 heat rate list.

"Those plants' burning higher-moisture coals should be congratulated for making this list," Hewson said.

In past years, parasitic load from pollution controls often kept plants out of the top 20, but this is becoming less of a differentiating issue because post-combustion controls are needed for continued operation, he said.

Future cooling water rules likely will degrade performance further for units with once-through cooling water systems and might drop some from list, Hewson said.

In 2013, a second ultra-supercritical unit, American Electric Power Co. Inc.'s Turk Plant, reached full operation, so it likely will hold the No. 1 or 2 spot on next year's list.

Table 4: Top 20 Nuclear Ranked by Generation (2012)

Rank	Owner/Operator	Plant	State	Capacity MW	Generation (GWh)	Capacity Factor	2011 Rank
1	Pinnacle West Capital Corp.	Palo Verde	AZ	3,937	31,934	92.3%	1
2	TVA	Browns Ferry	AL	3,355	26,078	88.5%	2
3	Duke Energy Corp.	Oconee	SC	2,567	20,647	91.6%	4
4	Luminant	Comanche Peak	TX	2,430	19,897	93.2%	6
5	Exelon Corp.	Lasalle Cty	IL	2,295	19,595	97.2%	7
6	Southern Co.	Vogtle	GA	2,302	19,558	96.7%	10
7	PSE&G	Salem	NJ	2,403	18,844	89.3%	17
8	Exelon Corp.	Braidwood	IL	2,357	18,806	90.8%	5
9	Exelon Crop.	Peach Bottom	PA	2,273	18,806	94.2%	8
10	NRG Energy Inc.	South Texas	TX	2,560	18,544	82.5%	3
11	Exelon Corp.	Byron	IL	2,323	18,318	89.8%	14
12	Exelon Corp.	Limerick	PA	2,341	18,156	88.3%	13
13	Duke Energy Corp.	McGuire	NC	2,285	17,968	89.5%	16
14	Duke Energy Corp.	Catawba	SC	2,292	17,829	88.6%	9
15	AEP	Donald C Cook	MI	2,130	17,719	94.7%	19
16	Pacific Gas & Electric Corp.	Diablo Canyon	CA	2,240	17,712	90.0%	12
17	Dominion	Millstone	CT	2,110	17,078	92.2%	20
18	PPL Electric Utilities Corp.	Susquehanna	PA	2,570	16,914	74.9%	18
19	TVA	Sequoyah	TN	2,305	16,586	81.9%	11
20	Exelon Corp.	Quad Cities	IL	1,819	15,506	97.0%	
				Total	Total	Average	
		Top 20 Generating		48,893	386,497	90.2%	
		EIA Reporting		101,820	769,331	86.3%	

Table 5: Top 20 Nuclear Ranked by Capacity Factor (2012) Avg. Summer + Winter Capacity

Rank	Owner/Operator	Plant	State	Capacity MW	Generation (GWh)	Capacity Factor	2011 Rank
1	Ameren Corp.	Callaway	MO	1,215	10,718	100.4%	
2	Exelon Corp.	Clinton	IL	1,072	9,374	99.6%	
3	Entergy Corp.	Indian Point	NY	1,042	9,002	98.3%	5
4	Xcel Energy Inc.	Monticello	MN	568	4,890	98.1%	
5	Exelon Corp.	Three Mile Island Unit 1	PA	817	7,038	98.1%	
6	Entergy Corp.	Pilgrim	MA	680	5,860	98.0%	
7	Exelon Corp.	Dresden	IL	1,725	14,802	97.7%	11
8	Exelon Corp.	Lasalle Cty	IL	2,295	19,595	97.2%	9
9	Exelon Corp.	Quad Cities	IL	1,819	15,506	97.0%	17
10	Southern Co.	Joseph M Farley	AL	1,734	14,763	96.9%	18
11	Southern Co.	Vogtle	GA	2,302	19,558	96.7%	
12	Entergy Corp.	Arkansas Nuclear One	AR	1,842	15,493	95.8%	
13	AEP	Donald C Cook	MI	2,130	17,719	94.7%	15
14	Entergy Corp.	Vermont Yankee	VT	601	4,989	94.5%	
15	Exelon Corp.	Peach Bottom	PA	2,273	18,806	94.2%	16
16	Energy Northwest	Columbia	WA	1,138	9,334	93.4%	
17	Luminant	Comanche Peak	TX	2,430	19,897	93.2%	
18	Southern Co.	Hatch	GA	1,759	14,383	93.1%	
19	Pinnacle West Capital Corp.	Palo Verde	AZ	3,937	31,934	92.3%	
20	WE Energies	Point Beach	WI	1,207	9,784	92.3%	
				Total	Total	Average	
		Top 20 Capacity Factors		32,586	273,446	96.1%	
		EIA Reporting		101,820	769,331	86.3%	

Nuclear Power Plant Performance

Nuclear Generation: Table 4

The units on this list are heavily utilized. Their fuel is cheap, and they are dispatched quickly. Plants with multiple units and high capacity make this list.

Three units normally considered for this list dropped out of the running in the past few years. Crystal River No. 3, shut down in 2009, remains offline and will not be restarted.

Fort Calhoun, shut down for scheduled refueling in April 2011, was not restarted. It remained offline after flooding on the Missouri River and was placed under federal control after an electrical fire and the discovery of several safety violations. The Nuclear Regulatory Commission planned to hold a public meeting in late November 2013 to discuss its restart. There isn't a timeline for restart, but according to an article in the Omaha World-Herald, its owner, Omaha Public Utility District, included the plant in its 2014 operating plan budget.

San Onofre Nuclear Generating Station, No. 15 on last year's list, was taken offline in January 2012 because of boiler tube failures. The plant remains

offline, and Southern California Edison announced in late summer that it will not be restarted.

Kewaunee Plant in Wisconsin was retired in 2013. The retirement is the first by a for-profit company and not a utility.

"This retirement shows signs of problems for IPPs that cannot cover large fixed costs with energy margins alone," Hewson said. "Additional retirements are likely, and new future capacity will depend on CO_2 regulations."

In 2015 or 2016, a new unit at Watts Bar will be added to the U.S. nuclear fleet, and some units have been uprated, so the total generation by nuclear plants should increase slightly in the next few years.

Nuclear Capacity Factor: Table 5

The story on capacity factor stays the same. The units that make this list weren't refueled during 2012.

"There is a lot of turnover on the capacity factor ranking list," Hewson said. "Unit refueling pushes stations off the list."

The threshold capacity factor for the top 20 plants dropped from 94.6 percent in 2011 to 92.3 percent in 2012. The average capacity factor for the top 20 plants also fell from 2011 to 2012, from 97.7 to 96.1 percent. The same was true for all EIA-reporting nuclear plants. The average capacity factor of the entire fleet was 89.0 percent in 2011 and 86.3 percent in 2012.

Gas-fired Combined-cycle Power Plant Performance

Gas-fired Combined-cycle Generation: Table 6

Gas-fired combined-cycle generation increased significantly between 2011 and 2012 from continued coal unit retirement and improved unit dispatch from continuing low natural gas prices. The plants in the top 20 list generated 23,225 GWh more electricity in 2012 than the top 20 generators produced in 2011. The entire EIA-reporting plants' production was up 188,798 GWh in 2012.

To qualify for the top 20 generation list, the plants had to generate much more electricity than in past years. The threshold for this list increased more than 1 TWh in 2012 to 6,858 GWh vs. 5,813 GWh in 2011.

Only three plants in 2011's top 20 didn't make 2012's top 20. Four of the 2011 top five remained in the top five in 2012.

Larger-capacity multiple train units have a distinct advantage, as do plants that operate in the East where coal prices are high.

"All of these plants have benefited from low (natural gas) prices," Hewson said. "Many on this year's list will likely continue to appear on this list as coal is retired in areas where coal prices are high enough to allow natural gas to replace it. This will eventually cause natural gas prices to go up."

Gas-fired Combined-cycle Capacity Factor: Table 7

The key to getting on this list is to have loads that require high utilization rates, which allows plants to make efficiency gains.

There is always turnover in this category. Eight plants that made the 2011 top 20 list were absent in 2012, including Nos. 1 and 5.

The threshold capacity factor for the 2012 top 20 was nearly the same as the 2011 threshold.

The average capacity factor of the top 20, however, was down 1.5 percent from 91.7 percent in 2011 to 90.2 percent in 2012.

Gas-fired Combined-cycle Heat Rate: Table 8

The top 20 heat rate list usually has much turnover, and 2012 was no different. Only half the plants from 2011 showed up on the 2012 top 20 heat rate list.

"The turnover from year to year shows how easy it is to drop out of this list," Hewson said. "Given that most use the same type of machinery (F machines), it shows how small differences such as elevation or temperature can impact performance."

The average heat rate of the top 20 plants was the same in 2012 as it was in 2011: 6.94 mmBtu/MWh.

The average heat rate of all EIA-reporting plants, however, was higher in 2012: 8.42 mmBtu/MWh vs 7.41 mmBtu/MWh in 2011.

Table 6: Top 20 Gas-fired Combined-cycle Ranked by Generation (2012)

Rank	Owner/Operator	Plant	State	Capacity MW	Generation (GWh)	Capacity Factor	Fuel Consumption mmBtu	Heat Rate (mmBtu/MWh)	2011 Rank
1	NextEra Energy Resources	West County	FL	3,669	24,356	75.6%	168,752,738	6.929	1
2	Duke Energy Corp.	Hines	FL	1,912	12,999	77.4%	92,952,250	7.151	2
3	NextEra Energy Resources	Martin	FL	2,043	12,111	67.5%	88,793,468	7.332	4
4	Southern Co.	Jack McDonough	GA	2,514	11,938	54.1%	82,280,987	6.892	
5	Southern Co.	Franklin	AL	1,815	10,863	68.1%	77,080,296	7.096	5
6	Entegra Power Group LLC	Union Power	AR	2,020	9,911	55.9%	71,601,012	7.224	13
7	NextEra Energy Resources	Sanford	FL	1,912	9,697	57.7%	72,674,153	7.494	3
8	NextEra Energy Resources	Forney	TX	1,760	9,106	58.9%	70,271,288	7.717	7
9	NextEra Energy Resources	Fort Myers	FL	1,432	8,933	71.0%	68,426,823	7.660	10
10	Duke Energy Corp.	Hanging Rock	OH	1,252	8,523	77.5%	56,933,613	6.680	20
11	Exelon Corp.	Mystic	MA	1,407	8,466	68.5%	62,454,918	7.377	6
12	Dominion	Fairless Energy	PA	1,211	8,230	77.4%	58,886,717	7.155	12
13	Southern Co.	Victor J Daniel Jr	MS	972	7,983	93.5%	56,376,191	7.062	15
14	Southern Co.	Barry	AL	962	7,943	94.0%	56,057,570	7.057	9
15	Duke Energy Corp.	Richmond	NC	1,102	7,706	79.6%	53,526,766	6.946	
16	Southern Co.	McIntosh	GA	1,257	7,534	68.2%	52,991,604	7.034	8
17	TECO Energy	Bayside	FL	1,630	7,120	49.7%	52,238,615	7.337	14
18	NRG Energy Inc.	Cottonwood	TX	1,180	6,993	67.5%	52,036,565	7.441	
19	Southern Co.	Wansley	GA	1,143	6,891	68.6%	48,477,436	7.035	16
20	Duke Energy Corp.	P L Bartow	FL	1,133	6,858	68.9%	51,804,309	7.554	11
				Total	Total	Average	Total	Average	
		Top 20 Generating		32,326	194,160	70.0%	1,394,617,319	7.21	
		EIA Reporting		210,592	972,131	46.3%	7,144,001,843	8.43	

Table 7: Top 20 Gas-fired Combined-cycle Ranked by Capacity Factor (2012)

Rank	Owner/Operator	Plant	State	Capacity MW	Generation (GWh)	Capacity Factor	Fuel Consumption mmBtu	Heat Rate (mmBtu/MWh)	2011 Rank
1	UBS	Black Mtn. Cogen	NV	85	729	97.6%	6,876,964	9.437	4
2	Carson Holdings	Carson Cogen	CA	49	411	94.9%	3,654,306	8.895	6
3	UBS	Nevada Cogen	NV	85	704	94.2%	6,416,731	9.119	3
4	Southern Co.	Barry	AL	962	7,943	94.0%	56,057,570	7.057	9
5	Oklahoma Gas & Electric	McClain Energy	OK	459	3,773	93.5%	26,580,048	7.046	
6	Southern Co.	Victor J Daniel Jr	MS	972	7,983	93.5%	56,376,191	7.062	
7	Manulife Financial	Michigan Power	MI	128	1,051	93.4%	9,574,545	9.114	2
8	NV Energy	Harry Allen	NV	423	3,412	91.9%	23,185,443	6.795	
9	Olympus Power LLC	OLS Energy Camarillo	CA	28	227	91.1%	2,003,450	8.843	12
10	Southern Co.	Lansing Smith	FL	481	3,814	90.3%	27,158,146	7.121	10
11	LS Power	Cherokee County Cogen	SC	86	676	89.5%	5,767,883	8.533	
12	JEA	Brandy Branch	FL	502	3,933	89.2%	27,772,764	7.061	
13	Rock-Tenn Co.	Jefferson Smurfit	CA	26	204	89.1%	2,196,276	10.792	7
14	Calpine	Pine Bluff	AR	192	1,489	88.3%	7,535,697	5.061	18
15	Foster Wheeler AG	Foster Wheeler Martinez	CA	104	792	87.1%	7,788,364	9.831	13
16	Sacramento Municipal Utility District	Cosumnes	CA	477	3,623	86.5%	25,123,687	6.935	
17	NRG Energy Inc.	Gregory Power Plant	TX	366	2,748	85.5%	11,573,922	4.211	
18	New York Power Authority	Richard M Flynn	NY	164	1,223	84.9%	9,714,201	7.944	14
19	Olympus Power LLC	OLS Energy Chino	CA	29	216	84.8%	1,955,353	9.054	11
20	Calpine	Delta Energy	CA	769	5,705	84.4%	42,297,319	7.415	
				Total	Total	Average	Total	Average	
		Top 20 Capacity Factors		6,387	50,653	90.2%	359,608,860	7.87	
		EIA Reporting		210,592	972,131	46.3%	7,144,001,843	8.43	

"There is a tradeoff between efficiency and flexibility," Hewson said. "Some unit designs trade losses in efficiency for improved operational flexibility, such as supplemental gas firing for peak load or gas cooling to increase output."

There is a large change in heat rate efficiencies between low and full load, and this list will be dominated increasingly by baseload units, he said.

Table 8: Top 20 Gas-fired Combined-cycle Ranked by Heat Rate (2012)*

Rank	Owner/Operator	Plant	State	Capacity MW	Generation (GWh)	Capacity Factor	Fuel Consumption mmBtu	Heat Rate (mmBtu/MWh)	2011 Rank
1	Duke Energy Corp.	Hanging Rock	OH	1,252	8,523	77.5%	56,933,613	6.680	
2	NV Energy	Harry Allen	NV	423	3,412	91.9%	23,185,443	6.795	
3	Southern Co.	Jack McDonough	GA	2,514	11,938	54.1%	82,280,987	6.892	2
4	WE Energies	Port Washington	WI	1,090	4,962	51.8%	34,316,929	6.916	
5	NextEra Energy Resources	West County	FL	3,669	24,356	75.6%	168,752,738	6.929	7
6	Sacramento Municipal Utility District	Cosumnes	CA	477	3,623	86.5%	25,123,687	6.935	20
7	Avista Corp.	Coyote Springs II	OR	243	1,142	53.6%	7,933,186	6.946	18
8	Duke Energy Corp.	Richmond	NC	1,102	7,706	79.6%	53,526,766	6.946	6
9	CPS Energy	Rio Nogales	TX	756	2,480	37.4%	17,252,429	6.956	19
10	Arkansas Electric Co-op Corp.	Hot Spring Power Project	AR	642	2,579	45.8%	17,958,977	6.965	
11	Puget Sound Energy	Goldendale Energy Prj	WA	257	897	39.8%	6,251,054	6.965	
12	Tenaska Inc.	Covert	MI	1,040	4,115	45.0%	28,670,443	6.968	
13	Portland General Electric	Port Westward	OR	372	1,729	52.9%	12,056,349	6.972	9
14	Oglethorpe Power Corp.	Chattahoochee Energy	GA	469	2,575	62.5%	17,963,088	6.975	
15	Calpine	Metcalfe	CA	546	2,801	58.4%	19,555,682	6.981	
16	General Electric	Inland Empire	CA	690	3,530	58.2%	24,649,199	6.983	5
17	Calpine	Fox Energy Center	WI	546	2,925	61.0%	20,469,115	6.998	
18	Avista Corp.	Lancaster	ID	248	1,215	55.8%	8,503,595	7.001	11
19	Tenaska Inc.	Tenaska Frontier	TX	860	4,963	65.7%	34,781,032	7.008	8
20	Sempra Energy	Palomar	CA	562	2,794	56.6%	19,596,178	7.014	
				Total	Total	Average	Total	Average	
		Top 20 Heat Rates		17,757	98,265	60.5%	679,760,490	6.94	
*Excludes co-generating facilities		EIA Reporting		210,592	972,131	46.3%	7,144,001,843	8.43	

Emissions

Coal-fired SO_2 Emission Rates: Table 9

Plants with scrubbers that burn low-sulfur coal have a distinct advantage in this category, Hewson said.

He said most of the plants on this top 20 list are over-complying with SO_2 requirements.

Seven of the top 10 from the 2011 list were back in the top 10 in 2012, including Ameren Corp.'s Coffeen plant, which kept the No. 1 spot. About half the plants on the top 20 list fell off from 2011 to 2012, however.

"There is a lot of turnover on this list because it doesn't take

much of an upset to knock a plant off the list," Hewson said. "Scrubbing is a chemical reaction, and it can be challenging if you have even the slightest upset. A plant must be consistent the entire year to make the list."

It was a little harder to make it onto the top 20 lowest SO_2-emitting coal-fired plant list in 2012 than in 2011. The 2012 threshold was 0.0512 lbs/mmBtu vs. 0.0561 lbs/mmBtu in 2011. The average SO_2 emissions for the top 20 also dropped in 2012, down to 0.0281 lbs/mmBtu from 0.0339 lbs/mmBtu in 2011.

"These rates are incredible," Hewson said. "These plants should be patted on the back for doing extremely well all year."

The story for all reporting plants is different than the top 20. In 2012, the average SO_2 emission for all reporting plants was up to 0.5975 lbs/mmBTU from 0.4912 lbs/mmBtu in 2011.

Coal-fired NO_X Emission Rates: Table 10

The plants on this top 20 list keep getting better, Hewson said. The average NO_X emissions rates for the top 20 in 2012 dropped to 0.0476 lbs/mmBTU from 0.0518 lb/mmBtu, although the threshold to make the list was up slightly from 0.0583 in 2011 to 0.0599 in 2012.

"The limit these top 20 plants achieve is amazing," Hewson said. "The average NO_X rate for a coal-fired plant is around 0.0800. These guys are beating that."

Unlike SO_2, not all NO_X comes from fuel; some of it comes from the air. To get to these levels, therefore, plants must have either post-combustion controls or be fluidized bed units.

Eight from 2011 dropped off the list in 2012. Two Kimberly Clark units that had not been on past lists showed up in 2012.

"This shows how just a small upset can make a big difference," Hewson said. "There is not much room for error with these levels. This list is mighty impressive."

The plants on this top 20 list also are over complying, many because of cap-and-trade programs, Hewson said.

As for all reporting plants, the level of NO_X emitted in 2012 was up slightly from 2011: 0.2270 lbs/mmBtu in 2012 vs. 0.2006 lbs/mmBtu in 2011.

Gas-fired Combined-cycle NO_X Emissions: Table 11

"The rates in this top 20 list are incredibly good," Hewson said.

The top 20 list improved from 2011 to 2012. The threshold to make the top 20 list dropped slightly from 0.00673 lbs/mmBtu in 2011 to 0.00622 lbs/mmBtu in 2012. The top 20 average dropped even more slightly from 0.0059 lbs/mmBtu in 2011 to 0.0055 lbs/mmBtu.

The average NO_X emission of all reporting plants did not improve. It rose from 0.0218 lbs/mmBtu in 2011 to 0.0368 lbs/mmBtu in 2012.

Two of the top three from the 2011

Table 9: Top 20 Coal Ranked by SO_2 Emission Rate (2012)*

Rank	Owner/Operator	Plant	State	SO_2 Mass (Tons)	Heat Input (mmBtu)	SO_2 Rate (Lbs/mmBtu)	2011 Rank
1	Ameren Corp.	Coffeen	IL	103	54,159,484	0.0038	1
2	Southern Co.	James H Miller Jr	AL	737	193,506,651	0.0076	8
3	Ameren Corp.	Iatan	MO	486	116,425,752	0.0083	2
4	WE Energies	Elm Road	WI	129	21,743,093	0.0118	4
5	Westar Energy	Jeffrey	KS	1,313	132,349,509	0.0198	5
6	WE Energies	Pleasant Prairie	WI	739	65,740,005	0.0225	6
7	Lower Colorado River Authority	Fayette	TX	1,117	95,839,007	0.0233	
8	Dominion	Virginia City	VA	168	14,314,852	0.0235	
9	Ameren	Duck Creek	IL	296	25,219,962	0.0235	3
10	AEP	Mountaineer	WV	1,151	83,123,698	0.0277	15
11	CPS Energy	J K Spruce	TX	1,402	97,960,607	0.0286	18
12	Public Service Enterprise Group	Hudson 2	NJ	139	9,651,735	0.0288	
13	TVA	Bull Run	TN	305	18,742,326	0.0325	13
14	Newmont Mining	TS Power	NV	215	11,827,234	0.0363	10
15	Salt River Project	Coronado	AZ	1,219	65,742,917	0.0371	
16	Xcel Energy Inc.	Bay Front	WI	68	3,469,748	0.0390	
17	Basin Electric	Dry Fork Station	WY	692	33,902,657	0.0408	
18	Black Hills Corp.	Wygen II	WY	165	7,107,755	0.0464	17
19	AEP	John E Amos	WV	3,133	124,532,808	0.0503	
20	First Reserve Corp.	Longview	WV	955	37,279,693	0.0512	
				Total	Total	Average	
* Excludes non-reporting and non-electric sector facilities		Top 20		14,529	1,212,639,493	0.0281	
		EPA Reporting		3,255,308	16,344,797,113	0.5975	

Table 10: Top 20 Coal Ranked by NO_X Emission Rate (2012)*

Rank	Owner/Operator	Plant	State	NO_X Mass (Tons)	Heat Input (mmBtu)	NO_X Rate (Lbs/mmBtu)	2011 Rank
1	GenOn Energy	Morgantown	MD	802	50,801,847	0.0316	1
2	Basin Electric	Dry Fork Station	WY	620	33,902,657	0.0366	
3	Suez Energy NA	Northeastern	PA	101	5,457,292	0.0371	2
4	Black Hills Corp.	Wygen III	WY	201	9,580,026	0.0419	3
5	Rich Family Companies	St. Nicholas Cogen	PA	240	11,248,881	0.0426	5
6	Newmont Mining Corp.	TS Power Plant	NV	257	11,827,234	0.0434	4
7	Rich Family Companies	John B Rich Memorial Power Station	PA	119	5,254,870	0.0453	
8	JEA	Northside	FL	258	10,951,579	0.0472	6
9	AES	Deepwater	TX	20	835,588	0.0482	
10	AEP	John W. Turk, Jr.	AR	44	1,800,016	0.0488	
11	NRG Energy Inc.	W A Parish	TX	3,526	143,880,352	0.0490	8
12	Seminole Electric Cooperative Inc.	Seminole	FL	1,854	73,415,440	0.0505	7
13	WE Energies	Elm Road	WI	553	21,743,093	0.0509	10
14	AEP	Mitchell	WV	1,869	73,411,554	0.0509	12
15	Cargill	Corn Wet Milling	TN	11	441,383	0.0514	
16	AEP	John E Amos	WV	3,240	124,532,808	0.0520	11
17	Kimberly-Clark Corp.	Chester	PA	166	6,248,380	0.0530	
18	AEP	Mountaineer	WV	2,264	83,123,698	0.0545	15
19	Dominion	Virginia City	VA	404	14,314,852	0.0565	
20	Gainesville Regional Utilities	Deerhaven	FL	279	9,328,343	0.0599	
				Total	Total	Average	
* Excludes non-reporting and non-electric sector facilities		Top 20		16,828	692,099,893	0.0476	
		EPA Reporting		1,536,533	16,344,797,113	0.2270	

Table 11: Top 20 Gas-fired Combined-cycle Ranked by NO_x Emission Rate (2012)*

Rank	Owner/Operator	Plant	State	NO_x Mass (Tons)	Heat Input (mmBtu)	NO_x Rate (Lbs/mmBtu)	2011 Rank
1	GE	Inland Empire	CA	48	25,027,198	0.00385	1
2	Occidental Petroleum	Elk Hills	CA	51	24,360,409	0.00420	
3	Sacramento Municipal Utility District	Cosumnes	CA	69	27,082,815	0.00511	2
4	Turrlock Irrigation District	Walnut	CA	34	12,876,910	0.00528	6
5	City of Orlando/ Orlando Utilities Commision	Curtis H. Stanton	FL	25	9,260,740	0.00530	9
6	Southern California Edison	Mountainview	CA	133	49,879,715	0.00534	11
7	Sempra Energy	Palomar	CA	59	21,933,743	0.00538	8
8	Public Service Enterprise Group	Linden	NJ	107	39,191,384	0.00545	
9	Florida Municipal Power Agency	Treasure Coast	FL	37	13,405,120	0.00559	4
10	Northern California Power Agency	Lodi	CA	3	1,173,249	0.00560	
11	Pacific Gas & Electric	Colusa	CA	60	21,073,187	0.00566	
12	New York Power Authority	500MW CC	NY	65	22,658,408	0.00570	
13	Southern Co.	Jack McDonough	GA	246	85,999,155	0.00571	
14	Calpine	Otay Mesa	CA	84	29,241,267	0.00572	5
15	Burbank Water & Power	Magnolia	CA	32	11,035,620	0.00589	
16	North American Energy Services	La Paloma	CA	124	41,079,398	0.00602	
17	MidAmerican Energy	Greater Des Moines	IA	12	3,973,578	0.00602	16
18	NV Energy	Harry Allen	NV	71	23,284,017	0.00606	
19	Southern Co.	McIntosh	GA	161	52,261,005	0.00618	19
20	Calpine	York	PA	87	28,010,278	0.00622	
				Total	Total	Average	
* Excludes non-reporting and non-electric sector facilities		Top 20		1,508	542,807,196	0.0055	
		EPA Reporting		70,588	7,318,588,981	0.0368	

top 20 list returned in 2012, including GE's Inland Empire plant, which retained the No. 1 spot. Half the plants that were on the top 20 list in 2011, however, did not return in 2012.

"Because technology captures such low levels, there is a lot of volatility in this list," Hewson said. "It doesn't take much to drop off the list."

Selective catalytic reduction (SCR) is installed on all machines that made this top 20 list.

"SCR is a must to get these low levels," Hewson said.

Half the plants on the top 20 list are in California.

"California has a problem with ozone. Its regulations are very strict, and NO_x is very expensive," Hewson said. "If you have a plant in California that can reduce NO_x, you can save money."

Editor's note: Energy Ventures Analysis Inc. provided all tables for this article. The annual operating rankings are published each year in *Electric Light & Power* magazine's November/December issue.

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