Black Days Ahead for Coal: Implications of EPA Air Emissions Regulations for the Energy & Power Markets

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See Disclosure Appendix of this report for important Disclosures and Analyst Certifications
Agenda

- EPA air emissions standards for SO2, NOx, mercury & acid gases will force costly upgrades of coal fired plants
- What are the implications for coal fired generation and U.S. utility demand for coal?
- How will a move away from coal affect the demand for gas?
- What will be the impact on energy prices?
- Which utilities are most at risk? Which may benefit?
Pending EPA air emissions regulations could require the installation of costly flue gas desulphurization equipment (SO2 scrubbers) across the U.S. coal fired fleet.

Many utilities will find it cheaper not to run older, smaller coal fired units than to retrofit them with scrubbers – driving a significant reduction in U.S. coal fired generation.

In July, the EPA released new regulations governing SO2 and NOx emissions in the eastern U.S., replacing the Clean Air Interstate Rule (CAIR).

By March of next year, EPA must issue new regulations governing hazardous air pollutants – mercury and acid gases – that will affect all U.S. coal fired plants.

To control hazardous air pollutants, sources must install Maximum Achievable Control Technology (MACT). For mercury and acid gases, MACT could comprise a costly combination of SO2 scrubbers, NOx emissions controls and fabric filters.
Profiling the Units At Risk

Capital Costs of FGD Retrofits ($/KW)

Source: EPRI, Bernstein Analysis

Capacity Profile of Unscrubbed Units

Age Profile of Unscrubbed Units

Capacity Factor Profile of Unscrubbed Units

Source: Ventyx, Bernstein Analysis
The average SO2 emissions rate for unscrubbed coal fired power plants is 0.92 lbs/MBtu. The average rate for plants with SO2 scrubbers (FGD) is 0.28 lbs/MBtu, with most emissions rates falling in a range of 0.15 to 0.32 lbs/MBtu.

Of the CATR states, 16 have SO2 emissions budgets that imply average emission rates of 0.36 lbs/MBtu or less – implying a need for widespread scrubber installation. Most at risk are small (<200 MW), unscrubbed coal plants in these states. These total 24 GW capacity and 105 million MWh output.

<table>
<thead>
<tr>
<th>State Abbreviation</th>
<th>CATR SO2 State Budget (Tons)</th>
<th>Average State SO2 Emissions Rate (lbs/MBtu)</th>
<th>CATR Budget Emission Rate (lbs/MBtu)</th>
<th>Unscrubbed Capacity (MW)</th>
<th>Unscrubbed Plants &lt;200 MW (MW)</th>
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Source: Ventyx, EIA, Bernstein Analysis
To assess which units will install scrubbers and which will not, we have compared the PV of (i) after-tax operating cash flows over a plant’s remaining useful life, given forward power and coal prices and the heat rate of the unit, with (ii) the cost of installing SO2 scrubbers, net of any tax benefits from the additional depreciation expense.

We assume that emissions controls are added at those plants where the PV of future operating cash flow exceeds the cost of installing scrubbers. Where they do not, we assume scrubbers are not installed – eventually requiring that the plant shut down to comply with the EPA’s hazardous gas regulations.

**Scrubbed and Unscrubbed Coal-Fired Generation in 2009, vs. that Expected in 2015 from the Existing Fleet Under: (i) the Transport Rule’s SO2 Targets for 2014 & (ii) an EPA Mandate to Install SO2 Scrubbers as MACT for Mercury & Acid Gases**

Source: Ventyx, EPRI, EIA, Bernstein Analysis
Impact on Coal Fired Generation

Our model suggests that in a scenario where all coal fired power plants must install SO2 scrubbers to meet EPA emissions standards for mercury and acid gases, the generation of the existing coal fired generation fleet can be expected to decline by 291 million MWh by 2015.

The output of new coal fired power plants expected to come on line over the next five years is estimated at 110 million MWh, reducing the net loss of coal fired generation to 181 million MWh.

Coal-Fired Generation in 2009 vs. that Expected in 2015, Given an EPA Mandate to Install SO2 Scrubbers as MACT for Mercury and Acid Gases (Includes New Additions of Coal Fired Capacity)

Source: Ventyx, EPRI, EIA, Bernstein Analysis
Impact on Coal and Gas Consumption

- U.S. utility demand for coal is estimated to drop by 116 million tons, or 12%. As most of the units expected to shut are east of the Mississippi, the consumption of eastern coals will be hit hardest, with demand estimated to fall by some 74 million tons, or 18%.

- If the 261 million MWh decline in coal fired generation is offset by a commensurate increase in gas fired generation, U.S. gas consumption would have to increase by a least 1.3 Tcf. All else remaining equal, this implies a 6% increase in U.S. consumption of natural gas by 2015.

Expected Reduction in Coal Burned by U.S. Utilities from 2009 to 2015 Assuming an EPA Mandate to Install SO2 Scrubbers as MACT for Mercury & Acid Gases

Expected Increase in Gas Consumed by U.S. Utilities from 2009 to 2015 Assuming an EPA Mandate to Install SO2 Scrubbers as MACT for Mercury & Acid Gases

Source: Ventyx, EPRI, EIA, Bernstein Analysis
Impact on Unregulated Companies: Power Output and Capex

Unregulated Generators: Potential Loss of Coal Fired Generation Due to EPA Regulation of Mercury & Acid Gases

Unregulated Generators: Scrubber Installation Costs Due to EPA Regulation of Mercury & Acid Gases (% of Market Cap)

Source: Ventyx, EPRI, EIA, Bernstein Analysis
Impact on Regulated Companies: Power Output and Capex

Regulated Generators: Potential Loss of Coal Fired Generation Due to EPA Regulation of Mercury & Acid Gases

Regulated Generators: Scrubber Installation Costs Due to EPA Regulation of Mercury & Acid Gases (% of Rate Base)

Source: Ventyx, EPRI, EIA, Bernstein Analysis
Impact on Power Markets

- The estimated decline in coal fired generation is expected to be sharpest in the Southeast and Midwest, affecting in particular four NERC reliability areas: the Southeastern Electric Reliability Council (SERC), the Southwest Power Pool (SPP), the Midwest Reliability Organization (MRO) and the ReliabilityFirst Corporation (RFC).

- Were the unscrubbed coal fired units in these regions to be retired, regional capacity margins would be reduced by 5 to 11 percentage points, to 8% in SERC, 8% in SPP, 10% in MRO and 12% in RFC. To avoid this outcome, we expect many of the affected plants to become subject to reliability-must-run or RMR contracts with their regional transmission organizations (RTOs), thereby ensuring the continued availability of their capacity to the grid.

Impact of Potential Coal-Fired Retirements on Regional Capacity Margin

Source: Ventyx, EPRI, EIA, Bernstein Analysis
Map of NERC Regions

Source: NERC
Sensitivity Analysis & Risks

- Our estimates of the decline in coal fired generation are very sensitive to the expected useful life of coal fired power plants and to the assumed level of forward power prices. Longer useful lives and higher gas prices increase the PV of future operating cash flows, rendering it economic to scrub a larger percentage of existing coal fired capacity.

- EPA may determine that emissions control technologies other than conventional SO2 scrubbers qualify as MACT for hazardous gases, significantly reducing the cost of environmental retrofits.

- In certain regions, gas fired capacity may be insufficient to replace the loss of coal fired plants.

**Sensitivity to the Age of Retirement of Coal Plants**

<table>
<thead>
<tr>
<th>Retirement Age</th>
<th>Expected Reduction in Coal Fired Generation</th>
<th>As % of Total Coal Fired Generation</th>
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</thead>
<tbody>
<tr>
<td>45</td>
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<tr>
<td>100</td>
<td>7%</td>
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**Sensitivity to the Forward Price Curve for Natural Gas**

<table>
<thead>
<tr>
<th>Shift in the Gas Price Forward Curve</th>
<th>Expected Reduction in Coal Fired Generation</th>
<th>As % of Total Coal Fired Generation</th>
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<tr>
<td>$(1.00)</td>
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<td>$(0.50)</td>
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<td>5%</td>
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<tr>
<td>$-</td>
<td>15%</td>
<td>10%</td>
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<tr>
<td>$4.00</td>
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Source: Ventyx, EPRI, EIA, Bernstein Analysis
Case Study: A Closer Look at the PJM Interconnection
Capacity by Fuel Type in PJM West and PJM East

**Capacity by Fuel Type in PJM West (MW)**

- Gas Plants, 29,714, 28%
- Oil Plants, 3,917, 4%
- Renewables, 2,372, 2%
- Hydro, 2,325, 2%
- Nuclear, 16,777, 16%

Coal Plants at Risk of Being Retired, 11,548, 11%

Remaining Coal Plants, 39,726, 37%

Source: Ventyx, Bernstein Analysis

**Capacity by Fuel Type in PJM East (MW)**

- Gas Plants, 20,508, 33%
- Oil Plants, 9,104, 14%
- Renewables, 928, 1%
- Hydro, 1,637, 3%
- Nuclear, 12,832, 20%

Coal Plants at Risk of Being Retired, 5,545, 9%

Remaining Coal Plants, 12,421, 20%

Source: Ventyx, Bernstein Analysis
Fuel Forecasts

Fuel Price Forecasts in $/MMBtu

Source: Bloomberg, Bernstein Analysis
Load Duration Curves For PJM West

PJM West Load Duration Curve in 2015 - Base Case Scenario

Source: Ventyx, Bloomberg, Bernstein Analysis

PJM West Load Duration Curve in 2015 - With MACT Retirements

Source: Ventyx, Bloomberg, Bernstein Analysis
Load Duration Curves For PJM East

PJM East Load Duration Curve in 2015 - Base Case Scenario

PJM East Load Duration Curve in 2015 - With MACT Retirements

Source: Ventyx, Bloomberg, Bernstein Analysis
Supply Curves For PJM West and PJM East

**PJM West Supply Curve in 2010, 2015 Base Case Scenario and With MACT Retirements**

Source: Ventyx, Bloomberg, Bernstein Analysis

**PJM East Supply Curve in 2010, 2015 Base Case Scenario and With MACT Retirements**

Source: Ventyx, Bloomberg, Bernstein Analysis
Impact of Proposed West-to-East Transmission Links

- Currently, different transmission projects are being developed in the PJM Interconnection to connect the western and eastern regions. These projects are scheduled to be completed by 2015.

- However, as with every major transmission project, there is a material risk that these projects might be delayed beyond 2015.

- As a result, we designed two scenarios to analyze the companies’ impact:
  - Unified Market Hypothesis: In this scenario, we assume that the transmission projects are completed by 2015, and therefore the PJM Interconnection operates as a single market all the time.
  - Two Markets Hypothesis: In this scenario, we assume that the transmission projects are not completed by 2015, and therefore the PJM Interconnection operates as two distinct markets for on-peak hours, but as a single market for off-peak hours.
Power Price Forecast for PJM West and PJM East Under our Two Scenarios

**Unified Market Hypothesis**

2015 Power Price Forecast for PJM West

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<tr>
<th>Year</th>
<th>Off Peak</th>
<th>On Peak</th>
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<tbody>
<tr>
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<td>$35</td>
<td>$41</td>
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<tr>
<td>2015 - Base Case</td>
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<td>2015 - With MACT Retirements</td>
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Source: Ventyx, Bloomberg, Bernstein Analysis

2015 Power Price Forecast for PJM East

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<thead>
<tr>
<th>Year</th>
<th>Off Peak</th>
<th>On Peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
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<td>2015 - With MACT Retirements</td>
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Source: Ventyx, Bloomberg, Bernstein Analysis

**Two Markets Hypothesis**

2015 Power Price Forecast for PJM West

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<thead>
<tr>
<th>Year</th>
<th>Off Peak</th>
<th>On Peak</th>
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<tr>
<td>2009</td>
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Source: Ventyx, Bloomberg, Bernstein Analysis

2015 Power Price Forecast for PJM East

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<th>Year</th>
<th>Off Peak</th>
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Source: Ventyx, Bloomberg, Bernstein Analysis
Loss of Generation in PJM by Company

Loss of PJM Generation by Company as Percentage of Total Generation

Source: Ventyx, Bloomberg, Bernstein Analysis
Gross Margin Impact by Company – Assuming PJM Operates as Two Markets During Peak Hours

Gross Margin Impact by Company as % of Last 12 Months EBITDA – Assuming Two Markets at Peak

Source: Ventyx, Bloomberg, Bernstein Analysis
Gross Margin Impact by Company – Assuming PJM Operates as a Unified Market During All Hours

Gross Margin Impact by Company as % of Last Twelve Months EBITDA – Assuming Unified Market

Source: Ventyx, Bloomberg, Bernstein Analysis
EPS Impact by Company – Assuming PJM Operates as Two Markets During Peak Hours

Source: Ventyx, Bloomberg, Bernstein Analysis
EPS Impact by Company – Assuming PJM Operates as a Unified Market During All Hours

Source: Ventyx, Bloomberg, Bernstein Analysis
Coverage
## U.S. Utilities Coverage

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<td>12.3</td>
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<td>3.21</td>
<td>3.36</td>
<td>3.65</td>
<td>13.6</td>
<td>13.0</td>
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<td>82.03</td>
<td>96.34</td>
<td>17.6</td>
<td>13.2</td>
<td>11.2</td>
<td></td>
<td></td>
<td>2.0%</td>
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</table>

O – Outperform, M – Market Perform, U – Underperform, N – Not Rated
Source: Bloomberg, Bernstein Analysis
Disclosure Appendix
Our target prices reflect the results of three alternative valuation methodologies: (i) a multiple-based valuation calculated by applying the median valuation multiples of a group of comparable companies to our estimates of a utility’s future earnings, dividends and EBITDA; (ii) a discounted cash flow model over the forecast period of 2010-2014, and a terminal value in 2015, discounted back to present value at the weighted average cost of capital; and (iii) a discounted dividend model over the forecast period of 2010-2014, and a terminal value in 2015, discounted back to present value at the cost of equity.
AEP: Our earnings and cash flow forecasts for AEP are driven primarily by our projections of load growth, future rate relief and the volume and profitability of AEP’s off-system sales. If our assumptions in these critical areas prove overly optimistic, our earnings and cash flow forecast may need to be adjusted downwards and with it our target price. Similarly, increases in operation and maintenance expense that exceed our forecast, or increases in the price of steam coal that further erode AEP’s gross margin on off-system sales, could likewise force a reduction in our earnings forecast and target price.

D: Risks to our earnings estimates and rating are primarily to the upside, and include (i) the impact of a more favorable outcome to VEPCO’s 2009 rate case on the segment’s EPS contribution in 2010 and beyond, (ii) the potential for natural gas and hence wholesale power prices to rise from depressed first quarter levels, expanding generation gross margin at the company's unregulated generation fleet, (iii) the potential, in a more favorable gas price environment, for a second sale of drilling rights in the Marcellus shale eliminating the need for the company’s planned equity issuance or 2010, and (iv) a recovery in the financial markets bringing about a reduction in pension expense.

DUK: Our valuation of Duke Energy by business segments, and our assessment of the upside and downside risks to our earnings forecast, support our $17 target price for the stock. Our long term EPS growth and our valuation of Duke Energy stock could be undermined, however, by the company’s failure to complete its planned expansion of regulated rate base as scheduled, or to recover a fair and timely return on this invested capital. A prolonged economic slow down could force Duke to delay its capital investment program. Duke also faces the risk of construction cost overruns -- and the possible disallowance of these costs by regulators -- when deploying relatively unfamiliar generation technologies, such as the Edwardsport IGCC. Finally, Duke’s regulated utility subsidiaries operate in jurisdictions where rates are set on a backward looking basis, i.e., based on a utility’s cost of service in a historic test year. Such backward looking rate setting mechanisms are disadvantageous when rate base is expanding rapidly, as rates set on the basis of historic test years fail to compensate adequately for rapidly rising depreciation and interest expense. This problem is compounded when regulated utilities are prevented from filing rate cases on an annual basis. Duke suffers from both disadvantages: in the Carolinas, Duke's 2010 rates are based on a 2008 test year, but the company may not file a new rate case until 2011, with any change in rates taking effect no sooner than 2012. In addition to risks associated with the implementation of its capital expenditure program, and securing the revenue increases required to earn a fair return on this incremental investment, Duke Energy could face significant compliance costs associated with new federal environmental regulations. While as a general matter these costs should be recoverable in Duke’s regulated jurisdiction, compliance costs could be formidable if Duke were required to install cooling towers at those nuclear and coal fired power plants that currently use once-through cooling. Similarly, the long term cost of compliance with a cap-and-trade scheme to limit emissions of CO2 could require very substantial upward adjustment in rates.

EIX: There are several possible risks to our price target. EMG’s large portfolio of coal-fired plants is exposed to gas price volatility. Our estimate of EMG’s value is based on current forward power prices, which in turn reflect the prevailing forward curve for natural gas. For 2010, the forward gas price averages $5.47/MMBtu, rising to $6.44 in 2011, $6.74 in 2012, and approximately $7.00 in 2013. All else being equal, we estimate that a $1.00/MMBtu increase in gas prices would add some $112 million in after-tax earnings at EMG’s coal-fired fleet, or $0.34 per EIX share. Thus a $1.00/MMBtu increase in the gas price, if perceived by the market to be sustainable and capitalized at an 8x P/E multiple, could add $2.70 to the value of EIX stock. Another significant risk to our earnings forecast is the prospect that federal or state government may impose a cap-and-trade scheme to limit power plant emissions of CO2. Coal-fired power plants in the United States emit, on average, twice as much CO2 per MWh (1.1 tons) as do their gas-fired competitors (0.6 tons). The impact on generation costs of a mandatory program of allowance purchases for CO2 emissions will thus be far greater for coal-fired plants than gas-fired generators. In the event CO2 emissions limits are imposed by the federal government, and allowances are sold by the government rather than allocated to generators for free, we estimate that an allowance price of $10/Mt would reduce EMG’s earnings by $81 million, or 7% of our 2010 forecast. It is possible that EMG might not be able to bring wind capacity on line as planned. Potential delays or cost overruns from turbine manufacturers, construction contractors, and power purchase contract negotiations could adversely affect our estimates of the earnings power from EMG’s wind portfolio. Risks at EIX’s regulated utility, Southern California Edison for the next five years are primarily associated with the investment programs that are subject to various regulatory proceedings. Although SCE has received its 2009 GRC decision, it only determined rates for 2009 through 2011. Some 70% of the 2009-13 capital investment program is to be determined by proceedings beyond 2009 GRC, including 26% under upcoming 2012 GRC, 12% under other CPUC proceedings, and 32% under FERC rate cases. Therefore the projected rate base growth from 2009 through 2013 would be affected by the outcomes of these various regulatory proceedings, posing risk for SCE’s earnings.
Risks

- **EXC:** Our estimates of Exelon’s future earnings are predicated on the currently prevailing forward price curves for power. As discussed above, a downward move in the forward price curve for natural gas, and a commensurate decline in on-peak power prices in PJM, would significantly reduce Exelon's long run earnings power. We estimate the earnings impact of $1.00/MMBtu increase in the price of gas at some $0.77 per share. In addition, our valuation and rating of Exelon stock are predicated on the assumption that CO2 emissions will be subject to cap-and-trade regulation by the federal government over the next five years. We estimate that a $10/Mt price for CO2 emissions allowances would increase Exelon's earnings by some $0.56 per share. The failure of the federal government to regulate CO2 would reduce our estimate of Exelon's value by some $5.00 per share.

- **FE:** Our estimates of FirstEnergy’s future earnings are predicated on the currently prevailing forward price curves. A downward move in the price for natural gas, and a commensurate decline in on-peak power prices at the western PJM hub, could significantly reduce the generation rates enjoyed by FirstEnergy's Pennsylvania subsidiaries when they transition to market-based pricing in 2011. Similarly, a downward move in the price of Appalachian coal could depress the prices received by FirstEnergy's Ohio utilities in their 2011 auction. These adverse price movements would erode the gross margins of FirstEnergy's competitive generation business. Second, were Pennsylvania regulators not to allow Pennsylvania Electric and Metropolitan Edison, at the end of their respective transition periods, to charge market-based rates for basic generation service, FirstEnergy's long term earnings power could be materially reduced.

- **NEE:** FP&L's earnings growth going forward will be driven by its MWh sales growth and clause related rate relief, as well as the outcome of future rate cases. Our estimate of FP&L's MWh sales growth is based upon NERC's forecast of power demand growth in Florida; should FP&L's actual sales growth be materially higher or lower than our estimate, the company's future earnings potential and value of could differ markedly from our estimate. Similarly, our estimate of FP&L's future revenue increase potential reflects the company's current pipeline of generation projects, which includes solar plants, nuclear uprates, and gas plant modernizations. To the extent these projects are not fully developed, our estimate of FP&L's base revenue growth, and consequently earnings growth, will be overstated. We have assumed that NextEra's wind power fleet will grow through the development of some 1,000 MW of wind capacity per annum, reflecting the expected availability of utility PPAs. A faster than expected recovery in power demand, or markedly higher gas and power prices, could increase utility demand for renewable generation and accelerate NextEra's earnings growth from new projects. NextEra could also begin to acquire renewable generation capacity in addition to building new plants. Our base case does not include potential acquisitions of renewable projects. On the other hand, the scheduled expiry of the production tax credit for wind in 2013 could slow the growth of renewable projects considerably. Our forecast of the NextEra's generation gross margin assumes that, as current hedges roll off, new hedges will be struck at currently prevailing forward power prices. Changes in gas prices could have material impact on forward power prices and hence on the gross margin of NextEra's generation fleet.

- **PCG:** The risks to our earnings estimates and rating for PCG are primarily related to the upcoming 2011 GRC, which will set PG&E's rates and rate base for the period of 2011 through 2013, and thus determine PG&E’s earnings for the period. Our EPS forecasts for 2009 and beyond, and our target price for PG&E, could be put at risk by significant revisions to projected capital expenditures over our forecast period, corresponding to regulatory decisions. Longer term risks include a reduction by the CPUC of PG&E’s allowed ROE and equity ratio.
Disclosure Appendix
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  Outperform: Stock will outpace the market index by more than 15 pp in the year ahead.
  Market-Perform: Stock will perform in line with the market index to within +/-15 pp in the year ahead.
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12-Month Rating History as of 07/19/2010

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Rating Guide: O - Outperform, M - Market-Perform, U - Underperform, N - Not Rated
Rating Actions: IC - Initiated Coverage, DC - Dropped Coverage, RC - Rating Change

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