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Global

Clean Power Plan: Focus on the big risks and don't rely on conventional wisdom

CPP creates new risk landscape for energy assets and prices; conventional wisdom may also be wrong

- **Investors primarily need to know one thing about the Clean Power Plan: whether it eventually happens or not, the plan is set to re-make risk and return in the US power sector. What matters most for investors is less understanding the details and more how the uncertainties should be priced into power sector economics on a dynamic basis.** The plan faces a gauntlet of legal, political, and implementation risk between now and its 2022 start date.

- **The key questions are when and how much these uncertainties and incentives will affect investment decisions and power prices.** The most straightforward way to price the risk in investment decisions will be to assume a carbon price. But what that price should be at any given moment is anything but straightforward.

- **Citi examines how significantly greater levels of risk impact both commodity and asset prices for coal, power, gas, and renewable energy in multiple scenarios.**

- **Conventional wisdom suggests that coal is the biggest loser, renewables are the biggest winners and gas should benefit somewhat. However, this expected outcome is not guaranteed; in alternate scenarios coal is much less of a loser, renewables get less support and gas becomes more of a loser.**

- **How these scenarios could play out depend on** (a) **relative prices** of gas and coal, (b) the value of **emission credits**, (c) the availability of **government support** on renewables in the form of PTCs and ITCs and (d) regional **electricity demand growth** as a function of energy efficiency and demand response efforts.

- **Although our base case assumes that coal's share in total generation would fall from the mid-30s% in 2015 to ~30% in 2022 and 25% in 2030, it is not a foregone conclusion that coal could not maintain its market share.** If the alternative scenario indeed plays out, gas demand for power generation could fall. With less domestic demand, gas prices could be under more downward pressure.

- **The CPP is a major step for US climate action going into the December UN climate negotiations, addressing the largest emitting sector in the US.** But the key implication of the CPP for global climate policy is not what it means for the UN process, but that it increases the possibility that other nations are willing to take on similarly strong domestic policies in their own economies.

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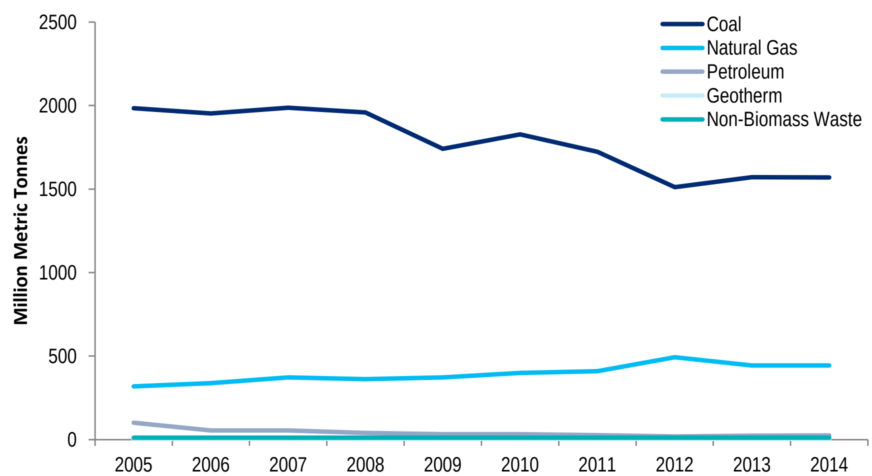
See Appendix A-1 for Analyst Certification, Important Disclosures and non-US research analyst disclosures.

CPP ushers in a new risk framework for the US power sector

Pricing major new risks matters more than plan details for now

At 1546 pages, the Clean Power Plan offers a lot of carefully calibrated details for how to decarbonize the US power sector. Investors primarily need to know one thing: whether it eventually happens or not, the plan is set to re-make risk and return in the US power sector. The organizing facts and principles are simple: the power sector is responsible for 31% of US greenhouse gas emissions, and coal is responsible for 77% of those emissions. Natural gas emits about half the CO_2 of coal and renewable energy has little to no emissions. Naturally then, reducing CO_2 means shifting the power sector to less coal, more renewables, and a healthy reliance on natural gas (with some use of other measures like energy efficiency). The plan is in some ways agnostic on what mix to use, allowing states to develop their own plans for compliance.

Figure 1. US power sector emissions are dominated by coal-fired power



Source: EIA, Citi Research

The plan faces a gauntlet of legal, political, and implementation risk between now and its 2022 start date that could impact its existence or eventual design. What matters most for investors, therefore, is more an understanding of how the uncertainties should be priced into power sector economics on a dynamic basis, rather than minute details of the current plan. A multitude of legal strategies will be employed to challenge the plan, some of which Citi addressed in the report "Supreme Court's EPA Mercury Ruling" (Jul'15). These challenges will have to first pass through Circuit courts and may eventually land at the Supreme Court. Typically, such legal challenges can take at minimum three years to reach resolution. With multiple challenges anticipated to simultaneously challenge the plan's raison d'etre as well as specific sections, guessing the outcome of these challenges may be a fool's errand (or a high-priced lawyer's).

In addition to legal risk, reminders of political risk should play out almost daily on cable news in dramatic pronouncements from the menagerie of Presidential candidates. Republicans are in near universal opposition, with Hillary Clinton on the Democratic side having already voiced her support. Finally, states have until 2016 or 2018 to submit implementation plans, leaving large uncertainties around how the regulation will interact with markets and investments.

Directionally, we know which way the economics are shifting but what we don't know is when or how much these incentives will affect investment decisions and power prices. The question is therefore how to dynamically price carbon pollution risk as new details and clarity gradually emerge on the long road to 2022. In a base case, coal will be penalized, renewable energy will be promoted, and natural gas looks to be neutral though with some possible twists to how things could play out. We examine below how key variable outside the scope of the plan could result in alternative outcomes to the base case.

The effects would be felt almost immediately, if softly, for a couple of reasons. First, investment decisions on power assets have a typical lifespan of 20 to 60 years. Current investments therefore have to price in risk and opportunity related to the CPP. Any investments now will impact assets, markets, and prices in the future. Second, the plan creates (nominal) incentives for early compliance under the Clean Energy Incentive Plan (see below for analysis).

Marginal costs of abatement key to pricing risk

In the face of many uncertainties, the most straightforward way to price the risk in investment decisions will be to assume a carbon price. The plan explicitly encourages a trading system. But what that price should be at any given moment is anything but straightforward, and will require regular updating. Expected carbon prices that should be used to measure risk in investments are a function of two factors: 1) the probability the rule lives and we have a carbon price[1], and 2) the anticipated value of the price should the rule survive. The first part will require regular analysis of the political, legal, and regulatory drama set to play out over the next seven years, with confidence intervals likely to improve the closer we get to 2022. The second requires analysis of the power sector for clues on the cost of emissions reductions.

In a market based system, the price of CO_2 should be set by the marginal cost of abatement. But the rule will not necessarily result in an economically optimal carbon market, adding a wrinkle to economic forecasting: whether the final rule will be implemented such that it motivates lowest-cost compliance, or incents more costly options, is somewhat uncertain. For instance, coal to gas switching is typically the "low hanging fruit" in carbon markets, but policy makers may prefer renewable energy for other reasons, which can be a more costly way to reduce CO_2 in the near term.[2] States may also chose compliance strategies based on local politics rather than low-cost optimization. Additionally, there are many moving pieces in the market that impact the marginal cost of abatement. Among them: the price of natural gas, the price of coal, the cost of renewable energy, and the level of macroeconomic activity.

We repeat: the takeaway from CPP for investors is all about pricing the evolving risks. Other carbon markets offer some signposts, but for now, we are "safe" assuming a carbon price somewhere between \$0 and \$50/ton (we recognize the irony in a \$50 band constituting "safe", hence our emphasis on dynamic pricing of risk). Figure 2 shows the history of carbon pricing in key markets. In the EU ETS, the world's largest carbon market to date, emissions pricing has ranged between zero and almost 30 Euros. California has seen allowances price between \$11/ton and \$23/ton. In the US Northeast's Regional

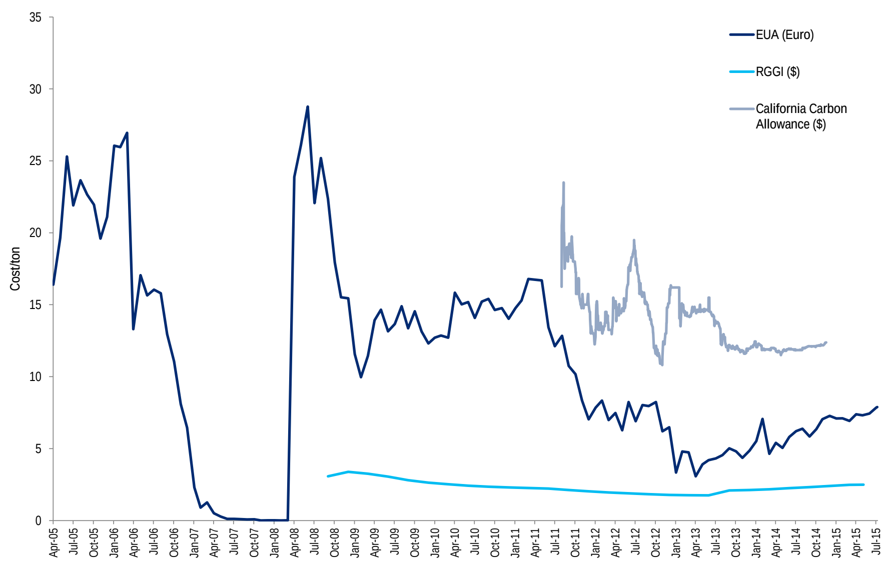
[1] We realize that trading is a possible compliance mechanism but that others exist. Nonetheless, alternative methods will a goal of reducing CO_2, which will come at a cost. They will therefore have a "shadow carbon price".

[2] Reaching longer-term, more stringent targets would at some point require renewable energy. But the EU ETS offers valuable lessons in what the marginal source of abatement

Greenhouse Gas Initiative Actions have been below $5/ton. In the US, the government has calculated its "social cost of carbon" around $40, but depending on assumptions could actually be higher.[3]

The marginal cost of abatement curve should make up of both the actual carbon reduction cost and coal-to-gas switching in the power sector, as switching away from coal to gas is also a carbon reduction strategy. Depending on the price of coal and gas, the marginal abatement cost (or carbon/emission credit price) could be the amount that makes gas more advantageous than coal. For example, at $35/ton for Illinois Basin coal and 10 heat rate for operating a generic coal plant, the marginal generation cost could be ~$19/MWh. At $3.5/MMBtu Henry Hub gas, the marginal generation cost of a combined cycle gas power plant should be around ~$26/MWh. The theoretical carbon price could be ~$14/ton. Of course there are other commodity price dynamic involved, but this could be the first step of a broader analysis.

Figure 2. Carbon prices in the world's major carbon markets have varied widely both over time and across markets (Europe, California, US Northeast)



Source: Bloomberg, Citi Research

Impacts of CPP risk on commodity demand and prices – conventional wisdom could prove very wrong

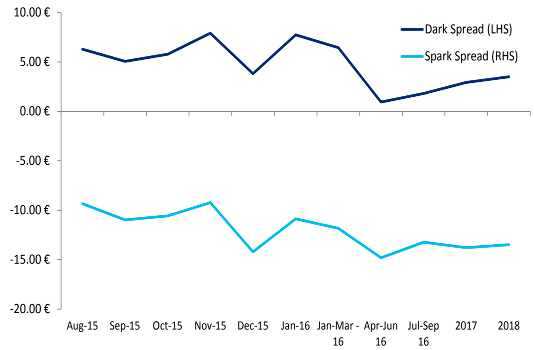
Conventional wisdom suggests that coal is the biggest loser, renewables are the biggest winners and gas should benefit somewhat. This is a realistic "base case".

However, under plausible alternative scenarios, the outcome could be surprising, with coal much less of a loser, renewables not getting as much support and gas becoming a loser. As shown in the below analysis, variables outside the control of the plan could dramatically alter outcomes. Those

3 http://www.epa.gov/climatechange/EPAactivities/economics/scc.html

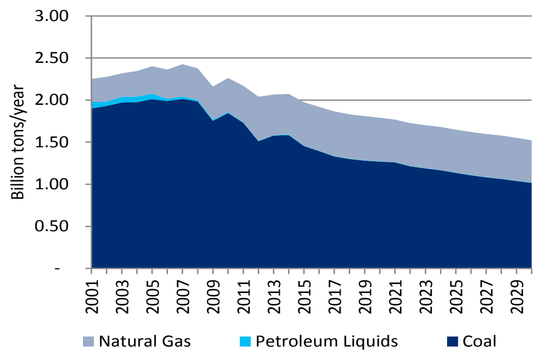
variables include commodity prices for coal and gas, emissions prices, and "complementary policies" for things like energy efficiency and renewable energy.

Figure 3. German clean spark vs. clean dark spreads show that even with robust carbon pricing, coal-gas spreads can still leave with a strong economic advantage



Source: Bloomberg, Citi Research

Figure 4. Emissions should fall and reach EPA's targets under a "base case"



Source: EIA, Citi Research

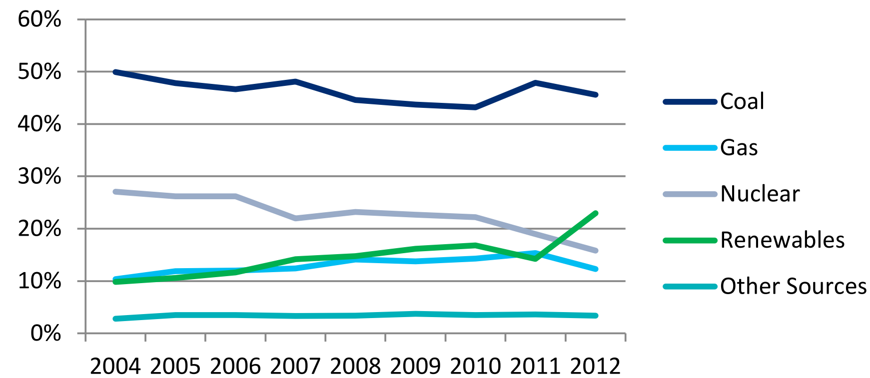
A concrete example is the European power market, commodity prices and complimentary renewable energy policies have at many times be more influential than carbon prices. In many places despite carbon pricing, gas burn fell sharply while coal burn remained strong (Figure 5). Forward clean dark and clean spark spreads reflect the fact that this situation is expected to continue going forward.[4]

The idea of having a two-prong strategy (carbon trading/offset programs and strong support for renewables) has historically generated results many found surprising. The implementation of a carbon market EU ETS[5] was anticipated to make a big dent in fossil emissions, particularly from the most polluting sources dominated by coal-fired generation. Gas-fired generation, which emits about half the carbon emissions at the point of generation, was expected to take market shares away from coal. But gas prices stayed elevated and remained uncompetitive, while emission permit prices were not high enough to tilt the generation balance strongly from coal to gas. Europe has had strong support for renewables generation via feed-in-tariffs (FiTs), leading to a surge in wind and solar installation. This kept power prices low, making utilities even more reliant on the low cost-generation – which is still coal.

[4] Clean spark (gas) and dark spreads (coal) indicate variable generation margins for generating assets, factoring in fuel costs, plant efficiencies, power prices, and carbon prices. In essence this shows a view of relative profitability of coal vs. as assets.

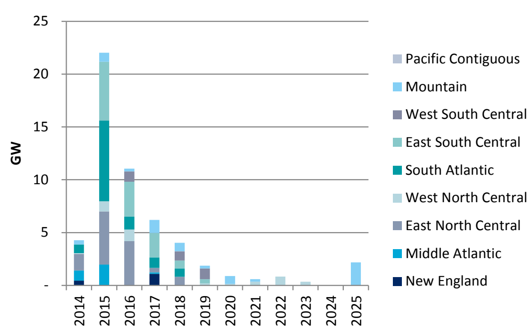
[5] EU ETS = European Union Emissions Trading Scheme

Figure 5. German electricity generation by source; coal remains surprisingly unchallenged despite carbon pricing and strong support for renewables



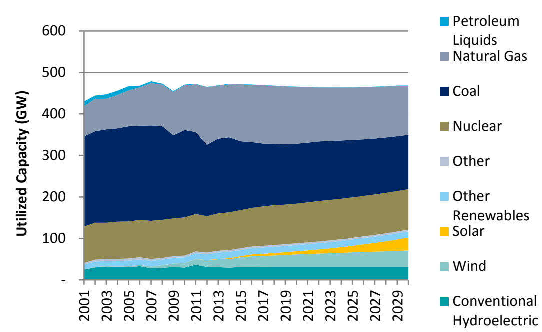
Source: IEA, Citi Research

Figure 6. Emission caps could still be met even with no changes to the current schedule of coal-fired generation retirement, but assuming a small, gradual decline (~1%) of capacity factor starting 2022 (US coal retirements)



Source: Reuters, company reports, Citi Research

Figure 7. With total electricity demand staying relatively flat amid rising renewables generation, both coal and gas could be squeezed. Coal-gas spreads will drive the battle for fossil market share.



Source: EIA, Citi Research

In the US, how these scenarios could play out depends crucially on market variables outside the control of CPP, including: (a) relative prices of gas and coal, (b) the value of emission credits, (c) the availability of government support for renewables in the form of PTCs and ITCs and (d) regional electricity demand growth as a function of energy efficiency and demand response efforts. An alternative case which might generate a relatively better future for coal would entail reduced support for renewable energy and high gas prices (see Figure 8). In this scenario it would take a much higher carbon price to reduce coal emissions.

Figure 8. Interactions of renewable energy policy and gas prices with the CPP can generate very different outcomes for coal

		Renewables	
		PTC *Extend*	PTC Expire
Gas	$ *High*	Coal Stable	Coal *Increase*
	$ *Low*	Coal *Decrease*	Coal Stable

Source: Citi Research

Broadly, the start of the CPP might impact prices for gas, coal and electricity at the start of the compliance period. It is possible to see a relatively small, though abrupt change in generation sources, as the cost of emission abatement goes from zero to some positive number once the initial compliance period begins. Forward curves for these commodities should eventually offer clues how the market is pricing these probabilities and risks as we approach 2022.

The potential rise in the marginal costs of generation, after factoring in emission compliance costs, could force some coal or gas power plants to shut. For these plants, knowing that they could face adverse economics after 2022 should alter their generation and price-bidding behavior before the compliance period. Why? Power plants that are facing potential closing would likely skim on maintenance and other costs, which would reflect in their marginal costs of generation. These plants should act as short-term cash flow machines if there is "no tomorrow". Having lower marginal costs of generation vs. other power plants should change how much fuel these retiring plants consume. Collectively their demand pattern matter because the share of fossil generation would go from ~70% in 2012 to ~50% when fully compliant.

Whether Congress extends renewable energy support policies will have a large impact on the pace of renewable energy expansion before 2022, and by extension the marginal cost of abatement when compliance starts. PTCs (Production Tax Credits generally for wind) and ITCs (Investment Tax Credits generally for solar) provide significant support to the current surge of renewables generation. Although prices of solar have fallen, in some cases at grid-parity to retail electricity prices, the availability of PTCs and ITCs still strongly affects the pace of growth in renewables installation in much of the country. This will impact greatly impact the power generation mix in the coming years, and by extension what incentives and investments are needed to meet CPP targets (see Fig 6).

The pace of regional electricity demand growth is also critical. In a scenario with higher power demand growth, total generation will be higher, which means the generation mix will have to lean more heavily on lower-carbon sources to stay within a carbon budget. This would favor gas or renewables to meet demand growth. But a lower demand growth scenario leaves more room for coal. If total generation is less, it's easier to meet targets, and emissions prices would be lower. This leaves more room for coal to compete with gas, and suggests coal-gas completion may come down to regional commodity market dynamics.

Regional commodity prices will have a big impact on these coal-gas competitive dynamics. For instance, coal plants that benefit from cheap delivered coal costs from low cost supply regions like the PRB will have advantaged economics. Similarly, for gas, Northeast plants that can take advantage of regional gas prices below $2/MMbtu will be advantaged relative to coal plants in the region that may be sourcing expensive coal from Central or Northern Appalachia.

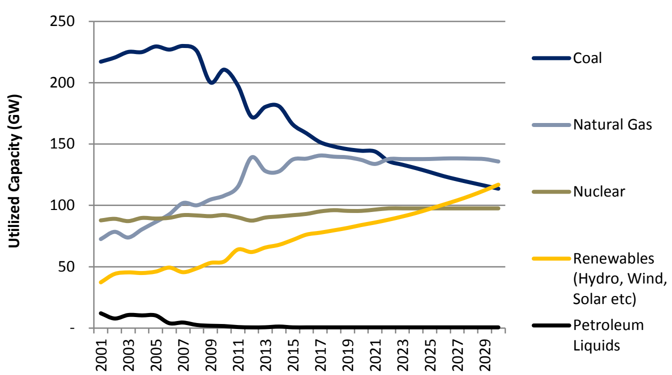
How would each fuel be affected?

Coal

Although our base case assumes that coal's share in total generation would fall from the mid-30s% in 2015 to ~30% in 2022 and 25% in 2030, it is not a foregone conclusion.

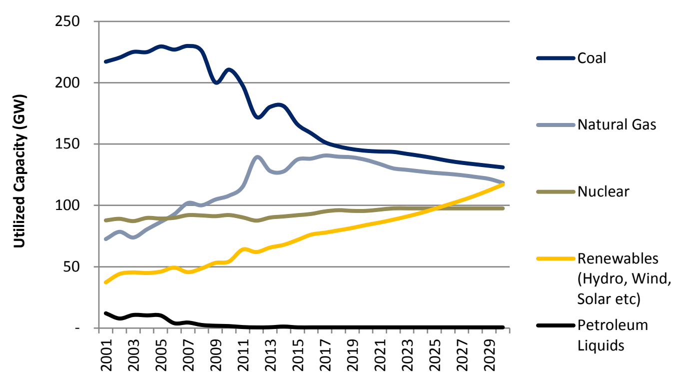
In our modeling, a slight loosening of the emissions cap in 2030 by allowing an additional 0.1-billion tons could raise coal's generation share from 25% back to nearly 30%. This is for illustrative purposes only to demonstrate the possibility that the generation mix could be highly sensitive to how the emission program is designed and a number of market conditions.

Figure 9. Base case – coal's share continues to fall while gas' share staying flat



Source: EIA, Citi Research

Figure 10. A slight loosening of the emission cap in 2030 could theoretically keep coal's generation share above that of gas



Source: EIA, Citi Research

The "more coal" scenario could bear out if gas prices were higher, coal prices were low and the marginal costs of abatement (likely reflected in emission credit prices) were low. How could they happen?

1. Gas prices could edge higher (a) if shale gas production declines much faster than expected, requiring more new drilling every year and (b) if drilling regulations become much more stringent. See the report "US Gas/Coal: Elusive Recovery for Coal" (Jul'15) for details.

2. Alternatively, even sub-$4/MMBtu natural gas prices could drive gas demand lower if delivered coal prices were able to fall more. This could happen if the mining and transportation costs of coal were to decline. This might happen if coal assets go into "fire sales" due to ongoing distress in the sector (see below). Both of these processes are highly diesel-intensive. With low oil prices, along with other cost reduction, the cost of open-pit mining could drop. (Underground long wall mining that is more common for Eastern coal may not benefit as much due to the inherent

complexity of this mining process.) Transport costs could make up more than 75% of delivered coal costs, especially for Powder River Basin coal delivery in Texas, for example.

Lower transport costs may come to fruition due to lower oil prices and lackluster demand for intermodal transport. Hence, suppose the current delivered cost of PRB coal in Texas is ~$40/ton, implying a ~$23/MWh marginal generation cost for a generic coal plant, which is competitive with $3/MMBtu Gulf Coast gas. Then a 25% fall in delivered coal cost to the $30/ton range should lead to a fall in marginal generation cost to ~$17/MWh. At this rate, gas prices would have to fall to ~$2.3/MMBtu to be competitive with coal, which may be unlikely. This gas price level is close to the marginal production cost up in the US Northeast, while the rise of US gas exports should support gas prices. The marginal emission abatement cost becomes key.

3. The marginal emission abatement cost hinges on the amount of excess emission credits in the market. This is the biggest unknown currently; in the EU ETS the allocation of free emissions credits was used as a political tool to build consensus among interest groups. Similar contentious issues over free allocation were a feature of proposed US carbon legislation in the past, including Waxman-Markey.

In addition, the renewal of PTCs and/or ITCs would affect the mixes of generation sources. See Figure 8.

This shows that in high gas price and no/low PTC/ITC scenario, renewables may fall short of expectation. Coal-fired generation could stay robust, particularly if total electricity demand were lower than prior years. This is possible because not as much gas-fired generation, with its lower emission profile, is needed to generate and meet electricity demand.

Natural Gas

The trajectory of gas prices depends on numerous factors, including ones that are outside of the power sector. Our base case continues to expect gas-fired generation to remain relatively flat to current levels, as seen in the graph above, with prices averaging $3.50/MMBtu long term. However, if the alternative scenario described in the coal section above indeed plays out, gas demand for power generation could fall. With less domestic demand, gas prices could be under more downward pressure.

If gas prices were to stage a modest recovery in 2017 and beyond, coal power plants may see their competitiveness improve relative to gas, except for regions flooded with low-cost Northeast gas due to new pipe connections.

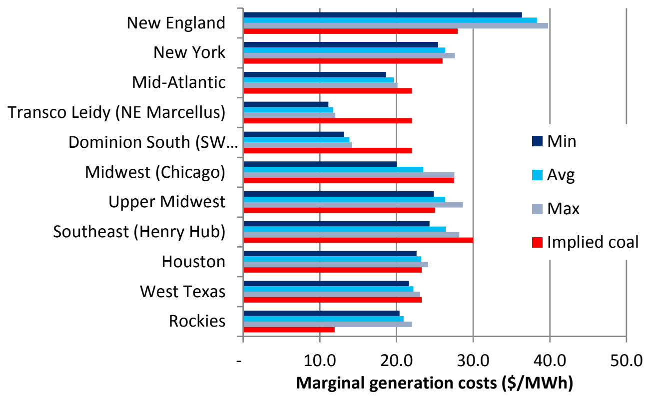
To illustrate the relative competitiveness of gas and coal, locational gas generation costs are derived using expected regional gas prices and last twelve months of thermal heat rates as reported by the EIA. We further categorize gas generation costs into "Min", "Avg" and "Max":

- "Min" refers to the lowest monthly heat rate reported and is used to show an approximate lower-bound in gas-fired generation costs. If the marginal generation cost of a generic coal power plant is comfortably below this level, then the coal plant there is highly competitive vs. gas.

- "Avg" is the average reported thermal heat rates in last 12 months of data.

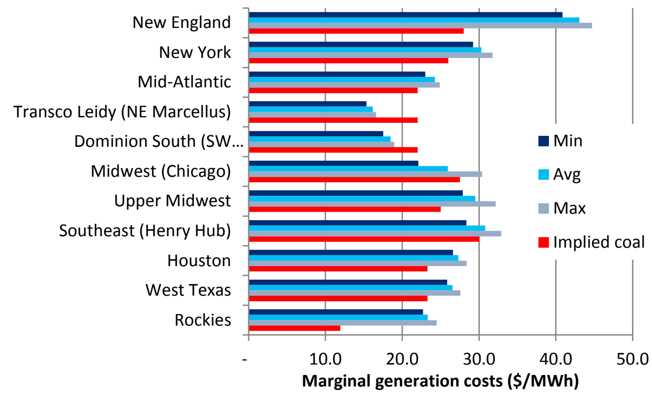
– "Max" refers to the highest monthly thermal heat rate reported and is used to show how high average marginal generation costs of gas plants could get in periods of high electricity demand.

Figure 11. Expected marginal generation costs of gas (Min, Avg, Max) and coal (Implied Coal) in 2016 at the regional level show that coal should continue to face severe challenges in most locations…[6]



Source: Platts, Citi Research

Figure 12. In 2017, although higher NYMEX gas prices should make coal relatively competitive, wider regional gas price discounts vs. Henry Hub should keep pressure on coal demand



Source: Platts, Citi Research

In the power sector, the continuation of PTCs and ITCs in support of renewables generation looks to keep gas burn flat or may even lower gas burn. Strong support for nuclear generation should also reduce the need for fossil generation. Even with coal-fired power plants shutting or reducing generation, gas-fired generation may not need to substitute for the loss of coal. Lower-than-expected gas demand for power generation should put downward pressure on gas prices. Citi's report "A Short Gas Bridge to Renewables" (May'14) highlighted such a possibility. This is consistent with our "base case" where gas remains highly competitive with coal.

Whether the next US President would continue this Clean Power Plan program in the current form also affects the overall demand for gas and coal.

How credits in the CPP's Clean Energy Incentive Program (CEIP) are valued, along with the future price of emission credits, also influences the generation mix, gas demand and gas prices. A high enough carbon price should make coal-fired generation much less competitive vs. gas, thereby lowering coal's generation share and coal demand. But the alternative scenario illustrated in the previous section shows that coal could still maintain a relatively more robust generation share than gas. This could happen, for example, if credits given out before the compliance period are applied to emissions during the compliance period from 2022 to 2030, thereby allowing emissions during the compliance to stay above the cap. This is possible because the banking of emission credits are often allowed in other emissions programs, such as EU ETS, and the SOx and NOx programs in the US.

Pushing back the compliance period from 2020 (as suggested in the draft rule released last year) to 2022 (as stated in the final rule just issued) should give states more time to design and implement programs that are favorable to renewables generation. The draft rule, with a shorter time toward compliance may lead to a

[6] Note: This analysis assumes the following for coal: $45/ton Central Appalachian coal, $35/ton Illinois Basin coal, $11/ton Powder River Basin coal and 10-heat rate for coal power plants.

dash for gas, because it is quicker and easier to build gas-fired power plants or build transmission lines linking to those plants.

Outside of the power sector, the size of future gas exports, the cost of gas production and even oil prices all have potential impact on gas prices. Very strong exports could lift gas prices and make coal-fired generation more competitive. This may lead to the alternate emission scenario, as shown in the coal section above, where coal generation would still maintain a higher share than gas generation.

Electricity

The risk may be biased toward power prices falling over time.

Greater energy efficiency, more demand response programs (especially during peak demand hours) and the increased deployment of rooftop solar should reduce the overall grid-connected electricity demand, with impact on peak power demand. Keeping electricity demand flat to lower should put downward pressure on power prices. These programs also have a disproportionate impact on peak power prices and heat rates – the latter in particular because there should be less of a need for peaking generation.

Offpeak power prices should also be under pressure. Higher shares of renewables and more generation from sources with near-zero marginal costs (e.g. nuclear) amid low electricity demand during offpeak hours should keep offpeak prices low. It is not uncommon for regions with large shares of these low-cost generation (at times much greater than local demand or transmission capacity is able to absorb) to see near zero or negative electricity prices.

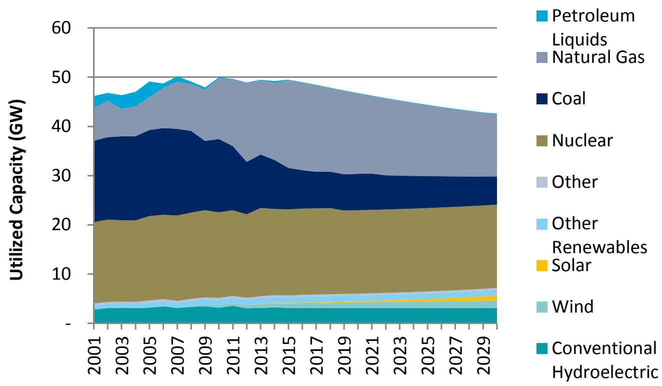
Prices would likely be more volatile than before with the rise of renewables generation due to their intermittent generation profile.

As power prices are functions of gas and coal prices, lower gas and coal demand, along with lower heat rates, should drag down gas and coal prices, all else being equal, which in turn should lower power prices.

As discussed above, plants that are looking to retire may run at a lower marginal cost of generation because they would likely skim on maintenance costs.

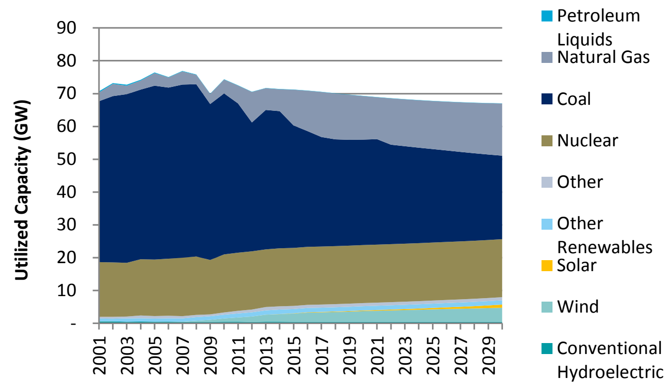
Regional Generation Outlook

Figure 13. Generation (Mid-Atlantic): stagnant overall growth but gas to gain as coal plants retire



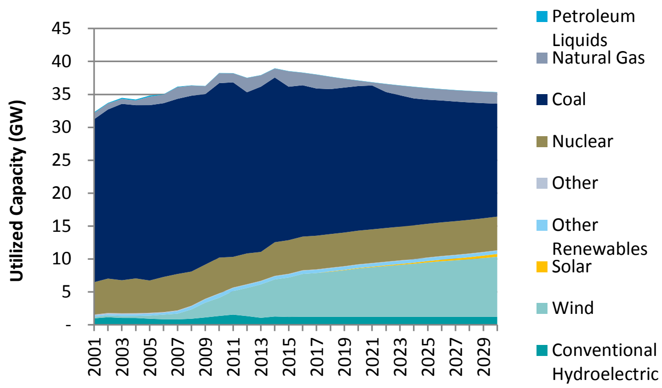
Source: EIA, Citi Research

Figure 14. Generation (East North Central): Coal plant retirements to benefit gas



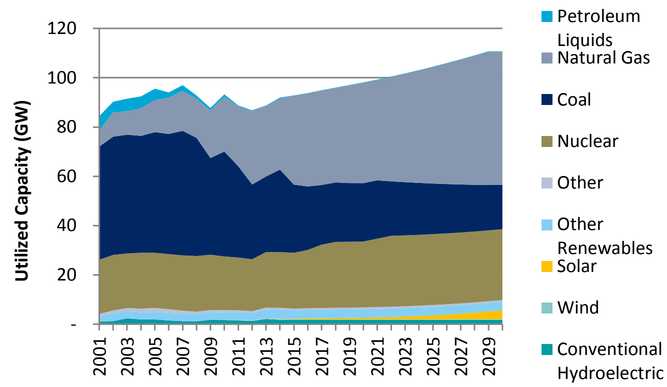
Source: EIA, Citi Research

Figure 15. Generation (West North Central): Wind capacity growth along the wind corridor could take market shares away from gas and coal



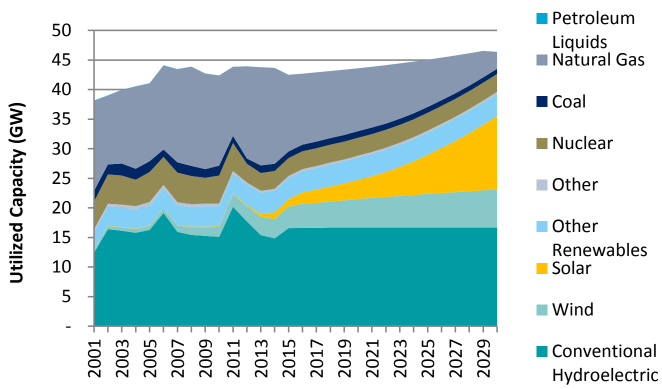
Source: EIA, Citi Research

Figure 16. Generation (South Atlantic): Coal plant retirements in the Southeast should benefit gas and nuclear



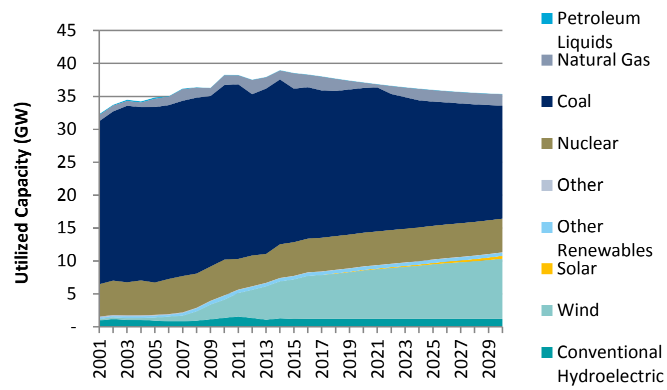
Source: EIA, Citi Research

Figure 17. Generation (Pacific): Renewables should make up a greater share of generation, particularly solar



Source: EIA, Citi Research

Figure 18. Generation (West South Central): power demand growth could slow down and wind growth could cut into gas' generation share



Source: EIA, Citi Research

Impacts on assets:

How "shadow carbon prices" impact energy asset investment prior to 2022

Crucially, while the CPP talks about emissions trading and credits, until clear property rights that can be valued by the market emerge, the most direct impact of the price on investment may be in the form of "avoided future liabilities" which disadvantage fossil investment. For instance, in the period where rules are still uncertain, if a utility is considering building a gas vs. a coal power asset, it should assign some additional future liability in its financial model for returns on the coal asset. That will advantage the gas asset on the margin, though by how much specifically will depend on how that investor prices the uncertain liability. Though notably, future coal generation investment was already projected to be minimal.

But the effect of the plan as a positive incentive for renewable energy investment may be weaker, as the market cannot yet easily price CPP's incentives or lend against them. A renewable energy developer might have a hard time borrowing against the unknown future value of credits; hence lenders may not allow renewable energy developers to price the benefit of such credits in their return models.[7] That said, a portfolio investor like a utility may seek to increase the share of renewables in its generation mix as a way to avoid total future carbon liabilities on its portfolio. That could create a greater bid from utilities on the margin for renewable assets.

Renewable Energy

It remains to be seen whether and how the Clean Energy Incentive Plan can incentivize stronger renewables investment. The EPA describes the CEIP's mechanism as follows:

> Under the CEIP, a state may set aside allowances from the CO_2 emission budget it establishes for the interim plan performance period or may generate early action ERCs (ERCs are discussed in more detail in section VIII.K.2), and allocate these allowances or ERCs to eligible projects for the MWh those projects generate or the end-use energy savings they achieve in 2020 and/or 2021. For each early action allowance or ERC a state allocates to such projects, the EPA will provide the state with an appropriate number of matching allowances or ERCs for the state to allocate to the project. The EPA will match state issued early action ERCs and allowances up to an amount that represents the equivalent of 300 million short tons of CO_2 emissions.

The EPA will address design and implementation details of the CEIP at a later date. Participation in the CEIP is optional and states would have to declare their intention to participate along with submission of their state's compliance plan; incentives would kick in after state plans were submitted, which could be as late as September 2018, or by September 2016.

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[7] An analogous situation is the pricing of renewable energy credits (RECs) in wind or solar investment models. Lenders may be hesitant to lend against future revenues from credit markets that 1) have no forward markets or illiquid forward markets, 2) cannot be hedged, or 3) have significant policy risk. RECs do have forward markets in many cases but these do not always extend as long as the life of the project.

Beyond the broader risks around the CPP, several key risks remain for renewables investors looking to the CEIP for support in the near term. The more predictable and stable the price signal is, the better incentive it will be. Current key risks include:

1) ***Risk to value of credits****:* in the framework of a larger traded market, we would expect the value of the credits to approach the marginal cost of abatement, which is itself uncertain. Before 2022, the Federal Government may need to set some minimum guaranteed price for the credits in order for them have much value as incentives for investors. Even when bankable for future compliance, if there is low visibility on their value post-2022, they may still be difficult to value and thus to transact or lend against.

2) ***Process risk****:* How and when the credits will be delivered, and who takes title when, will impact the ability to translate the credits into expected cash flows and lend against the credits. European emissions registries were hacked and the EU ETS experienced major frauds associated with emissions credits in examples of process risk to emissions trading systems.

3) ***Timing Risk****:* States cannot offer the credits until they have submitted their compliance plans. This could happen by either 2016 or 2018 depending on the state's timeline. If a state ends up delayed in submitting its plan, a project could lose several years' worth of credits.

4) ***Political Risk****:* So far, numerous governors have announced their intentions not to comply with the CPP, highlighting the potential discord between state implementation and Federal implementation. If states are responsible for distributing credits, projects may face the risk that a change in the State House to unfriendly governors might result in a hold up in credit distribution.

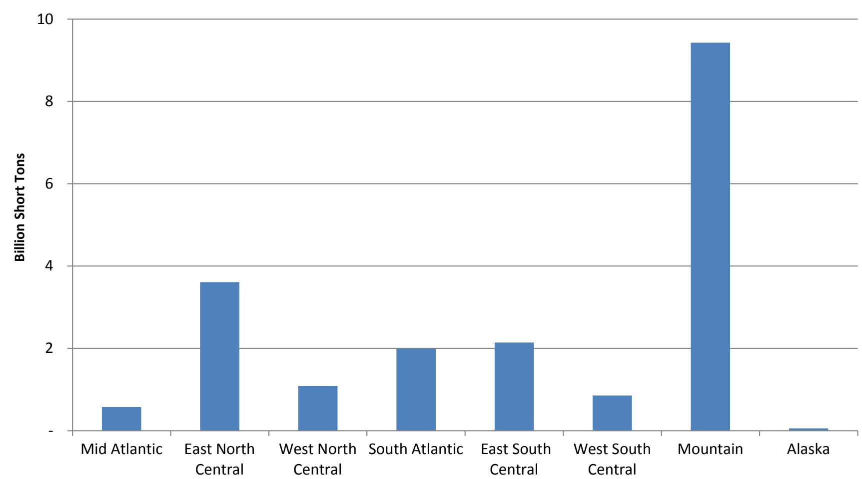
Until this plan is translated into a concrete economic incentive which investors can comfortably translate into cash flows, the renewal of the PTC and ITC will remain much more important for the future of renewable energy. Congress is now considering extension of the current renewables tax credits in an "extenders" package working its way through both Houses. Without such an extension tax incentives would start to drop off rapidly after 2016. Extension of the credits in their current or a modified form would provide a major continued incentive for renewables development, likely having a strong impact on the pace of development of utility scale wind and solar. **Without this extension, the CEIP looks like poor substitute for the near term, with renewables exposed to a waiting period to find out whether the CEIP translate into a viable incentive program the markets can utilize.**

Coal

Coal assets are the highest probability loser from the CPP. But how the CPP impacts coal assets is far from pre-determined; variables in the gas and renewable energy market may shape how badly those losses are (see alternative scenario above). As seen in the price analysis section in the previous section, there are multiple possible equilibria for the power markets that will depend crucially on variables such as renewable energy tax incentives and the natural gas price.

A difficult question is how to revalue long-lived coal assets such as coal reserves. Investors now face a scenario where high carbon prices combined with rapid renewable energy penetration could force significant impairments of booked US reserves if coal forward curves collapse. (Figure 19) shows booked reserves from producing mines in the US by region.

Figure 19. US coal reserves from producing mines by region



Source: Citi Research

But the situation in coal markets was already so bad some US coal producers may not be around in their current form to see their asset values be impacted by CPP implementation. Figure 20 shows default probabilities on major US coal producers. US coal assets are already experiencing impairments due to low natural gas prices and adverse market conditions. Alpha Natural Resources filed for bankruptcy this week, with more producers in line for distress. The coal industry certainly will not like CPP, but much of it may not be around in its current form to see the plan implemented.

Figure 20. Default risk on many US coal producers has been rising as the sector has become more distressed

	1 YR Default Probabilities (%)
SGZH	37.55
ANRZ	16.95
LLEN	8.72
BTU	7.44
RNO	5.399
WLB	3.4
NRP	2.985
WMLP	2.205
CLD	1.716
CNX	0.76
FELP	0.638
SXCP	0.196
ARLP	0.121
AHGP	0.074

Source: Bloomberg Default Risk Model, Citi Research

CPP risk to reserve asset values may therefore be more of an issue for coal company creditors as they evaluate asset coverage for a sector facing distress, or for potential bidders for distressed mining assets. With many major producers' equity trading near zero at option value, potential additional reorganizations are on the horizon. If assets are sold or restructured in a Chapter 11 process, CPP risk will likely be carefully evaluated. **Longer-term, under CPP, restructuring may actually allow a smaller sector to emerge leaner and meaner to better compete under the new rules of a CPP.**

Natural Gas

Impacts on natural gas reserve assets will be function of CPP's impacts on gas price. We expect that CPP in a base case scenario may be marginally positive for gas prices through supporting gas demand relative to coal (see above). However, if the alternative scenario as discussed in the coal section were to take place, where coal's generation share continues to stay above gas, gas could be the loser. In general, gas supply response may be adequate enough to damp any major price response. See the report "The New American (Gas) Century II" (Apr'15) for details.

Climate impact

The US and China have jointly pledged to fight climate change by implementing new greenhouse gas (GHG) emission targets. Commitments by these two countries are significant. The US pledges to reduce its emissions by 26-28% below its 2005 level by 2025, while China intends to achieve the peaking of CO_2 emissions around 2030 and to increase the share of non-fossil fuels to ~20% by 2030.

Based on our current analysis, the Clean Power Plan might require additional reductions outside of the power sector to meet aggregate targets. Our case assumes, in particular: (i) current policies on CAFE standard and RFS2 biofuel blending for motor vehicle efficiencies; (ii) continued growth in natural gas demand as industries take advantage of robust supply and low cost gas; (iii) Citi's existing forecast for coal-fired generation retirements (Figure 6) ; (iv) the base case oil and gas demand assumptions used in Citi's GPS report "Energy 2020: Out of America"; and (v) the implementation of the Clean Power Plan. But whether and how many additional measures are needed to meet aggregate targets will depend on the eventual shape and implementation of the plan, which is subject to the numerous uncertainties we have described in this report.

This scenario would only reduce economy-wide GHG emissions by 16% in 2025 vs. 2005's level, and 19% in 2030 vs. 2005's level. In 2005, the US emitted ~6.0-billion tons of GHG. Emissions are expected to fall to 5.3-billion tons in 2025 and 4.9-billion tons in 2030. For an earlier analysis on the US-China emissions agreement, please see the report "The New Climate Order" (Nov'14)

Figure 21. US policies could reduce 2030 emissions by ~19% vs. 2005 levels

	2011	2015	2020	2025	2030
Petroleum (mb/d)	**19.0**	**19.0**	**18.5**	**17.6**	**16.7**
Natural Gas (Bcf/d)	**66.8**	**76.0**	**83.2**	**87.0**	**90.7**
Residential+Commercial	21.6	22.5	23.2	23.2	23.2
Power Generation	20.7	25.5	24.6	24.7	24.4
Industrials+Others	24.5	28.1	35.4	39.0	43.1
Coal (MMtons/yr)	**1,003**	**844**	**731**	**636**	**564**
Power Generation	932	783	683	600	536
ex-Power Generation	70	61	47	37	28
Emissions (Bn tons/year)	**5.49**	**5.38**	**5.25**	**5.03**	**4.86**
Emissions vs. 2005	92%	90%	88%	84%	81%

Source: Citi Research

In the end, the CPP is a major step for US activity on climate change. Power is clearly the sector that matters most for emissions reductions, and the CPP is a detailed, credible attempt to address emissions from the sector. That said, policies in transport and industrial sectors could also play an important role (CAFE standards are one such policy).

The policy puts the US in a strong position going into the Paris COP 21 climate negotiations this winter, sending credible signals that the US as one of the world's top emitters is ready to lead. This will surely improve the prospects for meaningful outcomes from international negotiations. But as long-term observers of the UN process will know, the UN process does not have a strong track record of driving international action or delivering credible, enforceable emission policies.

The key implication of the CPP, therefore, may be that it increases the possibility that other nations are willing to take on similarly strong domestic policies in their own economies, whether or not the UN process yields any action or headlines.

Appendix A-1

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