GREENHOUSE GAS SPILL-OVER FROM THE US CLEAN POWER PLAN INTO THE PARIS AGREEMENT

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Overview

Climate change has been identified as one of the today's great challenges, and mitigation likely requires policy intervention. As such, in 2015 the United States introduced the Clean Power Plan (CPP) which aims to reduce CO_2 emissions from electricity production by 32% from 2005 levels by 2030, and adopted the Paris Agreement that promises to reduce national greenhouse gas (GHG) emissions 26%-28% from 2005 levels by 2025. However, it remains unknown how the narrowly-scoped (i.e. CO_2 emissions in the electricity sector) CPP might affect the ability to achieving the wider-scoped (i.e. GHG emission in the United States) Paris Agreement. This study finds that, due to currently inexpensive fuel, the CPP is most economically met through large shifts from high-emitting coal power to less-emitting natural gas power. However, recent evidence of fugitive methane emissions from gas extraction and transmission means that expanding the gas infrastructure will contribute additional GHG emissions. This result demonstrates the need to coordinate the two policies – either through additional policy (e.g. regulation of fugitive methane emissions) or a larger-scoped CPP that includes upstream activities.

In economics, a spill-over effect is a situation where an activity has an unintended consequence on another seemingly unrelated activity. Relocation of carbon-intensive production outside the bounds of stringent carbon policy (i.e. carbon leakage) is the foremost example of spill-over from emission regulation. Here, the spill-over is cross-sectoral in that emissions increase in sectors outside the scope of the mitigation policy (i.e. outside the CO_2 emissions in the electricity sector). This idea echoes arguments for life-cycle instead of production-based emission policies.

The CPP is limited in that it focuses only on CO_2 emissions from electricity production. Several studies indicate that the most economic way of meeting the nationwide emission target is, at least in part, via fuel-switching from high-emitting coal power to lower-emitting natural gas as well as further capacity expansion in gas power. In fact, this is observed in data following the fall in gas prices in 2008-2009.

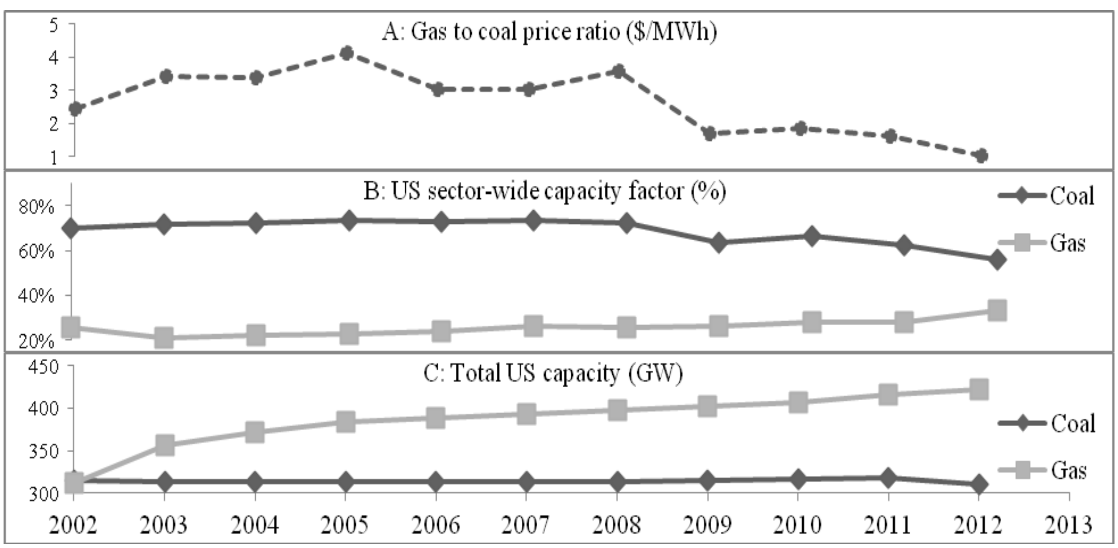

Figure 1. Decreasing gas prices (relative to coal) starting after 2008 (A) led to fuel-switching to gas from coal (B) as well as increasing expansion in gas capacity (C).

The fall in gas price raised the idea of natural gas as a "bridge fuel" to a low-carbon electricity future, with much debate. One of the most recent concerns over increased natural gas production is from methane emissions (25x more potent than CO_2) from extraction and transmission that occur prior to combustion in a gas power plant. Estimates of fugitive emissions from production, transmission, distribution, and end use range from 2.2% (EPA, 2011) to 7.9% (high-end from Horwath et al. 2011) of total production, with a majority of studies settling closer to the lower value (e.g. McKain et al. 2015). Whatever the actual value may be, these fugitive emissions would not fall under the purview of the CPP, but would be accounted for in the Paris Agreement. How much is the increased gas production used to meet the CPP affecting the Paris Agreement target.

Methods

There is, of course, great uncertainty in answering this question. First, models that predict large shifts to gas power assume that current natural gas prices represent a "new normal". This may not be the case due to price rebound effects especially in the face of possible liquefied natural gas exports. Second, the CPP itself faces challenges in Congress as well as the Supreme Court where it is, at the time of publication, put on hold. Third, estimates of fugitive emission rates span a wide range. Scenario planning tests different "states-of-the-world" in the same modeling regime can tease out the important contributions to the result. We propose eight different scenarios created from different combinations of three factors: i) pre- and post-shale boom gas prices, ii) with and without CPP implementation, and iii) low- and high-end estimates of fugitive emissions.

These eight scenarios are analyzed with model that projects electricity generation arising from both fuel-switching and capacity expansion out to 2030 (Peters and Hertel, *in review*). Fugitive emissions are assumed to increase in fixed proportions to electricity production. That is, if gas power expansion increases gas fuel demand by 10%, fugitive emissions from both gas extraction and gas pipelines are expected to increase 10% as well.

Table 1. Possible future states for scenario-based planning: 2007 vs. 2014 gas price; CPP vs. No CPP implementation; and low vs. high fugitive emissions.

Past as Future (2007 BAU)		CPP: policy-only	
(1) 2007 gas price No CPP Low fugitive	(2) 2007 gas price No CPP High fugitive	(3) 2007 gas price CPP Low fugitive	(4) 2007 gas price CPP High fugitive
Gas-only (2014 BAU)		**CPP: gas+policy**	
(5) 2014 gas price No CPP Low fugitive	(6) 2014 gas price No CPP High fugitive	(7) 2014 gas price CPP Low fugitive	(8) 2014 gas price CPP High fugitive

Preliminary Results

Preliminary results indicate that if 2014 gas prices represent a "new normal", then gas power will increase over 70% at the expense of coal power, with or without the CPP. That is, in scenarios (5)-(8), emissions in the electricity sector are met largely as a by-product of inexpensive gas rather than the CPP. Because of the increase in production, transmission, and distribution of gas, fugitive emissions are high, compromising the ability to meet the broadly defined Paris Agreement., despite the relative ease of meeting the CPP. With 2007 gas prices, the CPP is met largely through wind and solar and the fugitive emissions are comparably small. However, the CPP is more costly. I will present fugitive emissions and policy costs for each of the eight scenarios in Table 1.

Brief Discussion

The scenario-based analysis begs the question: where are we now? and what do we think that state-of-world will be in 2030 now? As of 2016, gas prices are comparable to 2014 prices, and there is no clear consensus that fugitive emissions from shale gas wells are significantly greater than conventional gas. This places us in either the (5) or (7) state; both of which indicate significant spill-over from the Clean Power Plan into the Paris Agreement, regardless of low or high rates from shale versus unconventional wells. In moving to 2030 the broader impact of the CPP will hinge on how much gas power is used to meet the target, driven by prices.

References

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