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WELDON COOPER CENTER for PUBLIC SERVICE

Rejoinder to VCCER's Response to Our Original Critique

William M. Shobe, 9/23/2015

In July of 2015, the Weldon Cooper Center published a critique (Shobe 2015) of a 2014 study done by the Virginia Center for Coal and Energy Research (VCCER 2014) for the Virginia Department of Mines Minerals and Energy on the cost to Virginia of complying with the EPA rule limiting greenhouse gas emissions from existing power plants, a rule known as the Clean Power Plan. The study was carried out by the. The VCCER has made a reply to our critique (VCCER, 2015b), which is available online. In this addendum, we evaluate each of the claims that VCCER made in its reply.

After a review of the VCCER reply, we conclude the following:

a. The VCCER mistake in under-valuing the social cost of carbon estimate appears to amount to about a 12.5 percent error rather than the 40 percent error we originally calculated.
b. The VCCER asserts that it used a 1.4 percent relative price deflator for future electricity costs rather than the 3.2 percent described in the text. *If this is true, then this discounting error was not as we described in our critique.* We cannot draw a conclusion on whether the 1.4 percent deflator is reasonable, since no mention of it is made in the text, and we do not know whether it was an appropriate choice. However, since this calculation was part of the double counting error in the original study, it shouldn't have been part of the study at all even had the costs been calculated correctly.
c. *In every other respect, the VCCER reply is either unresponsive or unsuccessful in responding to our original points.* We present detailed rejoinders on each point.
d. Furthermore, our review of the calculation of the benefits of emission reductions turned up inconsistencies in the values described in the text and the values presented in the table. Given the description in the text, it was not possible to tell what gave rise to the discrepancy or how serious any error might be.
e. Finally, in rereading the report for the preparation of this rejoinder, we found two additional, serious mistakes in the economic impact analysis used in the study. A large mistake in the calculation of the job intensity of electricity generation from renewable sources invalidates the economic impact calculations. Moreover, the calculation of job losses in coal, as described in the text of the report, uses a non-standard multiplier for the sector ***and*** misapplies the multiplier, the latter error alone amounting to a 25 percent *overstatement*

of job losses. Since VCCER defends its methodology, we expand on our explanation concerning the inappropriate use of input-output analysis as applied to this case.

➔ **All of the main conclusions from our original critique remain.** The report sets faulty baselines, presents bloated costs in its compliance scenarios, double counts compliance costs, and misstates the economic impact of the costs (as estimated) through both numerical errors and a poor choice of methodology. In sum, the VCCER reply does not change our conclusion that the original report grossly overstates costs of compliance and fails to provide guidance to policy makers on key policy design choices.

The faulty baseline

Throughout its report, VCCER compares compliance scenarios to its Scenario 2. And yet, it is clear in both the original report and in the reply to our critique, VCCER failed to construct Scenario 2 so that it could serve as a valid baseline against which to measure the cost of complying with the federal regulation.

VCCER claims that it would have been "presumptuous" to make any forecast of future renewables and efficiency, so it used zero for both.

In explaining why they made the wildly unrealistic baseline assumption that renewables and efficiency efforts would remain at their 2012 levels, the VCCER reply makes the following claim:

> It would have been presumptuous of the VCCER team to unilaterally attempt to anticipate what updates the Virginia legislature and Governor might make to the current voluntary renewable portfolio standard (RPS) program in light of the pending EPA CPP regulations.

No such changes in the state renewable energy goals were required in order to get a more sensible baseline, so the VCCER need not have worried about being presumptuous. Dominion has repeatedly claimed that they would meet the renewable goal through a combination of in-state generation and REC purchases. Our analysis only applied the renewables and energy efficiency already in Dominion Power's Integrated Resource Plan available to the authors at the time they wrote their report. Our estimates required no action by either the legislature or the executive branch of state government.

In fact, the authors used the Dominion estimated demand growth rate from that very same report on the grounds that it was reliable because Dominion published it there. Our estimates on renewables were intentionally conservative. They did not include planned renewables and efficiency efforts from APCO or other generators in the state. They did not even acknowledge the ongoing reductions in the cost of wind and solar.

They did not mention Apex Wind Energy's plans to develop wind power in Virginia. They did not acknowledge the increased use of residential rooftop solar installations. Information on all of these things was available to the authors at the time they drafted their report.

The claim that the authors did not want to be presumptuous by describing likely developments in renewable energy belies the fact that they made *many* assertions about the future. They made assumptions about natural gas prices, about the relative dispatch between coal and natural gas, and about countless other things. And, as we have already noted, VCCER was unwilling to use data from Dominion's IRP on renewable generation or on energy efficiency but was willing to use Dominion's estimate of the growth rate in electricity demand from the exact same source.

The VCCER reply makes the following statement:

> It should be noted that the 2012 base-line scenario was not included to demonstrate compliance with the draft regulations, but merely to illustrate the basis for comparisons of the compliance scenarios.
>
> In the four compliance scenarios of the VCCER report, both the "economic dispatch" and "green dispatch" analyses showed substantially increasing renewable energy and conservation MWh's. See Table A below for comparison of the amounts used in each analysis.

This is rather confusing. It *seems* to be saying that, since Scenarios 1 and 2 are not used to demonstrate compliance but are just for illustrative purposes, that they do not need to be a characterization of what would have occurred without the regulation. The renewables end up in the compliance scenarios, so not to worry.

It is a first principle of policy analysis that establishing a reasonable baseline scenario is essential for correctly estimating compliance costs. Throughout its report, VCCER uses Scenario 2 as the baseline against which it estimates cost of compliance. To not have reasonably anticipated the renewables generation and efficiency savings that would have occurred without the rule, clearly **overstates cost of compliance** estimates in the report.

VCCER confirms that the baseline NGCC capacity factor assumptions are not correct as a baseline.

In the previous section, where we addressed assumptions about renewables and efficiency, we showed that VCCER appears not to believe that Scenario 2 has to be a reasonable counter-factual because it is not a compliance scenario. This issue crops up again in the discussion of VCCER's clearly unrealistic assumptions about baseline capacity factors at Virginia's new NGCC power plants in Warren and Brunswick counties. To show the damage that this approach does, we start with an extended quote from VCCER's reply:

Scenario 2, which seems to be the sole focus of this comment was intended to isolate and evaluate only the singular impact of EPA Building Block #2 (preserved nuclear) upon the calculation of the Commonwealth's CO_2 emission rate using 2012 capacity factors for all generating units. Scenario 2 represents a baseline and is not one of the compliance scenarios; therefore, the capacity factors for the new NGCC's were held near zero to isolate the impact of the EPA CPP-suggested 6 percent preserved nuclear input.

In subsequent scenarios, where compliance was the primary focus, the new generating capacity from the new NGCC generation was unconstrained and thus dispatched at the following high capacity factor (CF) levels in accordance with the building blocks cited in EPA's proposed rule:

Scenario 4 Economic -2020 - all 2,580 MW of the Warren and Brunswick capacity were dispatched at a 65 percent CF.

Scenario 4 Green – 2020 – all 2,580 MW of the Warren and Brunswick capacity were dispatched at a 65 percent CF.

Scenario 4 Economic and Green for 2025 - (following EPA CPP Appendix 2 guidance) all MW's of this new NGCC capacity was again dispatched at a 65 percent CF.

Scenario 5 Economic -2020 - all 2,580 MW of the Warren and Brunswick capacity were dispatched at a 70 percent CF.

Scenario 5 Green – 2020 – all 2,580 MW of the Warren and Brunswick capacity were dispatched at a 70 percent CF.

Scenario 5 Economic and Green for 2030 - all MW's of this new NGCC capacity was again dispatched at a 70 percent CF.

Scenario 6 Economic -2020 - all 2,580 MW of the Warren and Brunswick capacity were dispatched at a 60 percent CF.

Scenario 6 Green – 2020 – all 2,580 MW of the Warren and Brunswick capacity were dispatched at a 60 percent CF.

Scenario 6 Economic and Green for 2030 - all MW's of this new NGCC capacity were dispatched at a 68 percent CF in 2030 (economic case) and at a 60 percent CF in 2030 in the (green case) respectively.

As shown in these data from the VCCER report, the critique that low CFs were used in the VCCER calculations is completely inaccurate.

First, we need to point out that the discussion in our original critique was all about VCCER not including reasonable NGCC capacity factors *in the baseline* and that the use of these inaccurate estimates in the baseline scenario would inflate compliance cost estimates for the compliance scenarios. These assertions in our critique are not

inaccurate. In fact, VCCER confirms the substance of our claim here in its response. They use unrealistically low capacity factors in their baseline scenario, Scenario 2, and then more realistic capacity factors in their compliance scenarios. Keep in mind that, throughout the report, VCCER uses Scenario 2 as the base against which they calculate the incremental cost of each of the subsequent scenarios (listed here). This fact is clearly noted in the tables in the report.

Once again, VCCER seems to completely misunderstand the use of scenario analysis for showing the difference between a business-as-usual baseline scenario and compliance scenarios. Their use of a low NGCC baseline in Scenario 2, since it makes the difference between Scenario 2 and the other scenarios appear larger, inflates their estimates of compliance costs due to the shift from coal to natural gas that occurs once the plants start to produce. Since these plants did not result from the Clean Power Plan, then not running them for the baseline and then running them for the compliance scenarios incorrectly inflates estimated costs. A correct baseline scenario is your best estimate of what would have happened without the regulation. Using low capacity factors at new NGCC units does not satisfy this criterion.

We have demonstrated several ways in which their approach overestimates the cost of compliance estimates that VCCER itself presents as incremental over Scenario 2. *VCCER's insistence that it is OK to have an unrealistic baseline scenario because it is not a compliance scenario (and this is made very explicit in the quote here) defies logic and calls into question the entire analytical exercise.*

VCCER had access to data showing that Dominion's electricity demand growth estimate was on the high side, but chose to ignore that data.

In defending the choice of an unrealistically high estimate for the rate of growth in electricity demand, the VCCER authors say only this:

> Several other assumptions directly impacted the analysis and interpretation of results included in the VCCER report. One critical assumption was the rate of growth in electricity demand. Virginia has not established an official growth rate, and estimates in the published literature varied from less than 1 percent to over 2 percent. In conducting this study, the projected rate of growth of 1.51 percent, used by Dominion Energy in their official 2014 submittals to the states of North Carolina and Virginia, was used to develop demand projections. The VCCER did not develop this growth rate, but chose to use a publicly available rate instead of making forecasts.

Even if there were an "official" forecast, the analyst has the responsibility of inquiring whether that forecast is reasonable. In this case, the forecast is made by a firm with every incentive to err on the high side in making its forecast. It is incumbent on the analyst to look behind the estimate.

Data available to VCCER at the time of their study clearly indicated that a 1.51% annual growth rate over the 18 years between 2012 and 2030 would be unlikely

(albeit possible), even for Dominion. In fact, Dominion was revising its estimates downward as VCCER was doing its report. An appropriate approach would have been to point out that this growth estimate is on the high side, given recent experience, and would tend to give higher estimates of compliance costs than if growth rates trend lower, as they have in recent years.

Cost calculations

VCCER authors claim that they did not double-count costs but are wrong again on this point.

The original report from VCCER contained a serious (and compound) error in estimating compliance costs. First, they overestimated the cost to the electric utility of implementing the changes needed to comply with the new rule, then they added to this another separate measure of the same thing. In their reply to this critique, the authors claim that they did not double-count and explain why they believe this. Their explanation is obviously incorrect, so we quote it at length here and then explain in detail why it was wrong before and is still wrong. The authors are making a very elementary mistake and have been unwilling to acknowledge this.

> In his critique, it seems that Dr. Shobe misunderstood the compliance cost discussed in our report. There is no "double counting" in the total compliance cost as presented in Table 8-3 in the VCCER report.
>
> In the EPA official documentation of the Clean Power Plan, as published in the Federal Register, compliance cost is defined as the following:
>
> > The compliance costs of this proposed action are represented in this analysis as the change in electric power generation costs between the base case and the proposed rule in which states pursue a distinct set of strategies beyond the strategies taken in the base case to meet the terms of the EGU GHG emission guidelines, and include cost estimates for demand-side energy efficiency [Citing EPA].
>
> It is clear that the compliance cost specifically means the change in the electric power generation costs. It should not be lumped together with other costs such as business or consumer costs. As a result, the compliance cost estimate in Table 8-3 of the VCCER report has no "double counting."
>
> We assume Dr. Shobe's allegation of double counting is referring to the business and consumer costs shown in Table 8-9 of the VCCER report. This is the worst-case scenario for business and consumer costs. We did not label these costs as the likely or realistic estimates of business or consumer costs, but rather, our report specifically states that these numbers are presented for illustrative purpose only, assuming 100 percent compliance cost can be passed along to customers. However, these costs are not the same as the compliance cost, and this is the cost to businesses and consumers where100 percent of the compliance cost from electricity producers is passed along to electricity users and is added to the increased cost of electricity from increased fuel costs, etc. The more likely scenario for business and consumer costs is represented in Table 8-5 of our report, which also does not include "double counting."

The first thing we point out is that, in our original critique, we were quite clear about where the double counting occurred. We noted that the compliance cost estimates in Table 8-3 were overblown and explained why. Then we pointed out that the figures in Table 8-5, labeled by the authors as business and consumer costs are actually a

different measure of exactly the same thing. Finally, we clearly noted that the VCCER double counting came in Table 8-9. There is no need for anyone to guess our intent, we stated it clearly on pages 23 and 24. We will leave this to the reader to judge whether the VCCER authors should have understood this.

As for the substance of the claim, the VCCER authors simply restate their claim that costs paid by businesses and consumers are not the same as compliance costs. They do not, however, make any showing of where these costs might come from if not from compliance costs. Because they persist in this claim we will go over this point in detail.

On page 6 of their reply, they reiterate that "…these costs [i.e. their estimates of business and consumer costs] are not the same as the compliance costs…". And yet, as we pointed out in our critique, the numbers they use for costs in Table 8-5 are taken directly from EPA's estimates of compliance costs; see the extended quote from EPA on page 23 of our critique. The VCCER report actually states this pretty clearly noting that Table 8-5 "…presents the costs of consumers and businesses assuming 100 percent of the compliance costs could be passed through to consumers." The authors appear to want to have it both ways: they are compliance costs but not compliance costs. While VCCER persists in the claim that "business and consumer costs" are somehow different from compliance costs, they have not yet been able to show where these "costs" come from if not from the costs of compliance. They seem to be confusing the measurement of costs with the *incidence of costs.*

To understand the misunderstanding, we have to first define "pass-through of costs." Suppose EPA implements a regulation that costs a utility $100 in compliance costs (i.e. labor, concrete, fuel-switching, etc.). If the utility cannot increase the price of electricity to reflect the increase costs, then the firm must absorb the costs. So, the costs fall on shareholders and on the firms that sell inputs for generation. This is the case of zero pass-through of costs. The full incidence of the costs falls on the firm and its suppliers; customers do not face increased costs of electricity.

If, as is the case in Virginia, the utility can recover most (if not all) of the increased costs, then some (most) of the compliance costs get passed through to customers in the form of increased electricity rates. Note well, the costs of compliance have not changed! But now, the utility is passing some of the $100 in costs along to consumers. In VCCER lingo, "business and consumer costs" have risen. What the VCCER authors do not appear to recognize is that the increase in costs to buyers of electricity also reflects a reduction in the share of compliance costs paid by the utility. We still have the same $100 in costs, but now they are paid by different people.

Just to be very clear. Suppose we use the VCCER language and call 100 percent pass-through the "worst case scenario". Well, it is the worst case scenario for buyers of electricity, but at the same time, it is the best case scenario for the seller, since the seller pays zero compliance costs. The pass-through rate is a measure of the *incidence* of costs, that is, how the costs are shared as between sellers and buyers.

For example, take a cost of compliance that we know is included in both VCCER's estimate and in EPA's estimate: heat rate improvements at coal plants. VCCER included this in their compliance scenarios (see pages 98-99 and others). EPA also assumed heat rate improvements as one of the things states would do to achieve compliance, and so would have included these costs in their estimates. So, when EPA calculates the increased electricity rates to consumers, they are including the portion of the cost of heat rate improvements that gets passed through to consumers. (Again, in Virginia, this pass-through rate will always be very high: close to 100%.) Now it is quite obvious that if you add VCCER costs to the costs derived from EPA's rate increase measure, you are very obviously double counting heat rate improvement costs. This same logic applies to the other elements of compliance cost. They are double-counted.

VCCER's mistake is even worse than it first appears because, if there is 100 percent pass-through, then the demand for electricity will fall somewhat, which means, in turn, that compliance costs as measured by the increase in generation costs actually fall. The demand elasticity for electricity is low in the short run but large enough in the long run so that this mistake, while harmless in the early years, becomes significant in out years.

Getting back to the VCCER report, the authors themselves state that Table 8-9 "…presents the costs of consumers and businesses assuming 100 percent of the compliance costs could be passed through to consumers." If there is 100 percent pass-through, this means that electricity generators are not paying any of the costs of compliance, but rather buyers are paying 100 percent. How then can they justify adding their measure of utility compliance costs to the 100 percent of compliance costs passed along to consumers?

Let's go through their arithmetic carefully and see where it gets us. Table 8-3 estimates net compliance costs for electricity producers from the Scenario 2 baseline. If there were zero pass-through of costs, then the row titled "Total Compliance Costs ($Million)" would be **utility** compliance costs; consumer and business costs would be zero. If pass-through were positive, then the total compliance costs would be **shared** between electricity buyers and utility company shareholders (and suppliers). You would not add your measure of total generator compliance costs to the portion of those costs paid by consumers. This would be a clear and simple mistake of double counting. [The **total** compliance costs would actually be a bit lower due to the effect of cost pass-through on electricity demand. So, the amount listed in Table 8-3 is the **maximum** compliance cost and is overestimated at that, as we demonstrated.]

Table 8-5 is labeled "Estimated Costs to Consumers and Businesses". It represents the incremental electricity costs to consumers and businesses due to the CPP, once we have accounted for pass-through. The original VCCER report actually notes that the costs in Table 8-5 are the portion of compliance costs passed through to buyers,

which by the way, under Virginia law, will always be pretty close to 100 percent in the long run.

Table 8-9 then takes this estimate from EPA of the compliance costs paid by buyers and add it to VCCER's own estimate of ***total*** *compliance costs (as those costs are laid out in Table 8-3).* We are not, as the VCCER authors claim, misunderstanding what they did here. What they did is painfully obvious and is a large, if elementary, mistake. It would be bad enough to present these figures only as a worst-case scenario, but the VCCER authors repeat these incorrect figures in their Table 8-23: Summary of Costs and Benefits ($ per ton of CO2 Emissions Reduction).

VCCER used a relative price inflator in calculating "business and consumer costs", so the size of the error caused by misusing these costs is smaller than we stated in our critique.

We have already dealt with VCCER's claims that it did not double count compliance costs. It obviously did, and we demonstrate this in detail earlier.

In Item 10 of their reply, the VCCER authors mistakenly claim that they did not over inflate costs in their report. There is a sense in which this doesn't really matter, because VCCER should never have added in these amounts, however they were calculated. But here is their claim on that point:

> Also on page 23 of his critique, Dr. Shobe states that the cost estimates included in the VCCER report "make a mistake by inflating the nominal electricity price before increasing them by the EPA estimated compliance cost factor of three percent. Then they present these estimates as being in 2012 dollars, which they are not, and make the mistake of adding 2030 dollars to 2012 dollars in the results." More specifically, he claims the VCCER study inflated the electricity price using the nominal rate. This statement by Dr. Shobe is incorrect. The VCCER report quoted the nominal price rate (3.5 percent), but used only the real rate of increase (1.4 percent, on top of general inflation) in estimating the consumer electricity cost. The cost estimates, therefore, are stated in 2012 dollars, not 2030 dollars as Dr. Shobe claims. There is no inflating of costs in the VCCER report.
>
> Dr. Shobe implies that the VCCER report includes intentional cost inflation as an indicator of bias on the part of the VCCER team. We reject these accusations which are not supported by a careful reading of the VCCER report. Dollar values were properly adjusted to account for time based discounting and all dollar figures are presented in 2012 dollars throughout the report. It is not clear how Dr. Shobe can arrive at this conclusion without verifying any underlying calculations behind the VCCER report.

Since the VCCER team suggests a careful reading of their report on this point, we will quote it from pages 155 ands 156 of the original VCCER report:

> …[T]he national study conducted by EPA economists on how the EPA's Clean Power Plan can affect national and regional electricity price was used as a basis. This study estimates

> that the CPP would increase electricity price by 2.4 percent in 2020 and 3.0 percent in both 2025 and 2030 (EPA, 2014g).
>
> … Based on historic data, it is assumed that Virginia's customer base will grow 0.8 percent per year, and the nominal electricity price will increase by 3.2 percent per year.
>
> Combining price change assumptions from the EPA's Clean Power Plan, Virginia's electricity customer base, and conservation cost estimated above, the resulting consumer and business cost is shown in Table 8-5. …

If it is true that VCCER used an estimate only of the rate at which electricity prices rise over the expected rate of inflation, *then we must give them a pass on this one*, even if we do not believe that even the most careful reader could have figured this out from their text. *While this does not eliminate the double counting, it does mean that VCCER did not incorrectly inflate the dollar amounts before double counting them.*

This raises one additional issue, however. If electricity prices are rising 1.4 percent faster than average for goods and services, then it makes even more unlikely continued growth in demand at 1.51 percent per year, but we have dealt with this issue elsewhere. There is also a question about whether the 1.4 percent increase has built into it expectations of future limits on greenhouse gas controls. If any of the 1.4 percent forecast real increase in electricity prices is due to controls that would be driven by the CPP, then this part of the costs is double counted. We can't make an assessment on this point, since VCCER never mentions the 1.4 percent in their report or where they came up with it.

Economic impact analysis

VCCER makes numerous generic statements about the Virginia coal industry, none of which justify its gross overestimates of the sensitivity of the industry to this regulation.

Less than half of Virginia coal mine output is used for domestic steam coal, much is used in metallurgical applications, and about 40% of it is exported. VCCER relied on "its significant experience and expertise" to inflate Virginia coal mine exposure to the domestic steam coal market to the national average of 93%. Virginia coal industry has been in decline for some years, partly due to existing regulations of coal combustion and partly due to its increasing production costs relative to alternatives: other coal producing regions, lower natural gas prices, reduced growth in energy demand, etc. It is simply not correct to assume that any reductions in sales of Virginia coal (not just steam coal but all Virginia coal) are the result of compliance with the CPP. But this is essentially what VCCER does. For example, the baseline assumption of low capacity factors for new Virginia NGCC units (discussed elsewhere) means that the reduced coal use due to the use of the new NGCC plants, is now assigned as a cost of

compliance with the CPP. As of late 2015, the Brunswick NGCC is clocking at better than 70 percent capacity.

Significant future loss of market share has to be anticipated regardless of the CPP due to the falling productivity of Virginia mines. VCCER makes this very point. Also, a substantial share of the reduced steam coal consumption in Virginia will come from reduced imports of coal from West Virginia. VCCER is effectively asserting that the loss of sales by West Virginia mines will result in a 1 for 1 loss of sales in Virginia mines. If it were true, *and it would be pretty remarkable if it were*, then they should be able to demonstrate this with data. They have certainly not done so either in their original report or since.

The relevant point for the current analysis is that this convenient assumption overstates the responsiveness of Virginia coal to changes in Virginia compliance plans, and contributes to the overstatement of economic impact because it means that the natural gas for coal import substitution exercise in the Chmura study is overstated. Some of the substitution of imported natural gas for coal is for imported West Virginia coal not Virginia coal. The estimate of the economic impact on Virginia then has to be scaled back accordingly. It is just another example in this report of exaggerating the likely effects of the CPP and it *compounds* with the errors of setting the baseline and double counting costs.

The VCCER authors make a fair argument that the low productivity of Virginia coal mines may make them more sensitive to reductions in national and international coal demand. But this is not enough reason to apply an unrealistic 93 percent share of Virginia steam coal to reductions in coal use in Virginia power plants. And, as we will discuss shortly, the argument that Virginia coal is at a competitive disadvantage and that its price will respond strongly to these competitive pressures is a strong argument all by itself that a static input-output model such as the one used in their report is an inappropriate tool to use in the analysis of job losses.

Finally, the VCCER study apparently did not include in its analysis the savings in extraction subsidies for the coal industry. Virginia pays on the order of $20 million per year in subsidies for coal extraction. Reductions in coal extraction in Virginia would reduce this spending. This savings must be subtracted from compliance costs, just as any state subsidies to solar and wind must be added in, if they are not already.

VCCER's economic impact analysis, as described in their report, makes at least two serious errors in calculating job effects and choses an inappropriate analytical methodology.

Preliminary note: While there is enough of a description of the economic impact analysis done for the VCCER report for us to spot a number of errors and to identify a number of ways in which the methodology was misapplied, we are not in a position to fully evaluate the report because VCCER has declined to share a copy with us. The

original report cites a study by Chmura Economics and Analytics, but VCCER has declined our request for a copy of that report. Thus, we do not know that such a report exists, and, if it does, what details it contains.

We do have enough information to know that VCCER's economic impact analysis is wrong for a number reasons. First, VCCER makes numerous mistakes in estimating the cost of compliance (as we have described in detail), and these inflated costs are fed into the input-output (i/o) model. This is just a garbage in/garbage out problem and is not a problem with the particular methodology used but will result in exaggerated impact estimates. Second, *the analysis, as it is done, is clearly incorrect* in some important respects, again over-estimating economic costs by a large margin. Third, VCCER misapplies input-output analysis to a case where it is known to be inaccurate and is almost guaranteed to overestimate aggregate cost measures. We have already discussed this last point, but since VCCER makes a vigorous defense of its methodology, we will expand on our discussion of why the standard i/o model will tend to overestimate economic costs in the circumstances to which it is applied here.

By way of introduction, the type of model used in the VCCER analysis is referred to as an input-output model.[1] These models use a set of numbers (fixed coefficients) to describe the average relationships between the various sectors of the economy. So one coefficient might describe the relative amount of total cast iron output used in engine manufacturing, and another coefficient might describe the relative amount of total engine output used in auto manufacturing, etc. These coefficients are estimated from data on the economy for the prices of goods in place when the estimates are made. By making a small change to the amount of some good demanded, we can trace the flows of market commodities through the economy in response to that small change. It is important to keep in mind that an i/o model just tracks money flows, it does not and cannot track the full economic value of those changes for reasons that are well known in the literature.

These models were, at one time, the best available tool for tracing small changes in economic activity. Unfortunately, these models, at least the static, plain vanilla version used in this report, even when used correctly, are subject to severe limitations that have greatly limited their use in modern economic analysis.

(1) The analysis must be limited to quite small changes where the relative prices of goods in the economy will not change. The reason for this is very straightforward. The fixed coefficient model assumes that the relative prices of all of the goods and services in the economy do not change. If prices change, then the fixed coefficients estimated under the old prices no longer apply. We will pay special attention to this issue later on, because it is central to VCCER's defense of the use of the i/o model in their study. Needless to say, the assumptions required for the use of a fixed coefficient are badly violated in

[1] The standard reference is Miller and Blair (2009). Many of the issues discussed here are treated in that book. The limitations of applying standard i/o models in the current context have been discussed *ad nauseam* in the peer-reviewed scientific literature since the 1970s.

this case, and the results will necessarily overestimate the true economic impact of a large change in demand for coal.

(2) Most i/o studies, the present one included, do not account properly for transfer payments such as unemployment payments, Social Security, disability payments, federal displacement assistance, and Medicare. They also do not account properly for changes in savings. So, for example, if a worker retires early as a result of a result of a policy, that worker will often draw a pension. Not accounting for this, as was apparently not done in this study, will over estimate economic impact.

(3) An i/o study, such as this, cannot take into account the benefits of environmental improvements. For example, suppose you spend $100 reducing pollution and earn $150 in reductions in payments to hospitals for medical expenses. The way VCCER type of study works is to run the $100 expenses through the i/o model to get the follow-on effects. But the study cannot treat the savings in medical expenses the same way. Even though the people exposed to the pollution are better off by $50, this improvement is not a gain to the economy in an i/o model. The $150 is taken out of the economy in one place and ends up elsewhere in the economy. Often it will come up looking like a loss to society because consumers will save some of their $150 gain. The solution used here is to leave environmental benefits out of the i/o analysis. They only get brought in separately, in this case as separately measured social costs of carbon and health benefits. Generally speaking, these external measures of environmental effects are not consistent with the i/o outputs they are combined with.

Mistakes in the economic impact study:

The economic impact starts with a very serious mistake in calculating the employment and follow-on effects of adding renewables. Since this mistake is made at the very start of the impact analysis and is used throughout, it pollutes all the results that follow.

Job intensity of renewables:[2] The original VCCER report contains the following quote:

> Employment in renewable plants was estimated using the following methodology. Firstly, employment data from JobsEQ indicate that total power generating jobs in renewable plants in Virginia was less than 90 in 2012, including jobs in hydroelectric and wind plants. In 2012, the total renewable electricity output in Virginia was 2.36 million MWh. Secondly, those data imply that each renewable job is associated with 26,600 kW annual electricity output. Thirdly, using that assumption, new renewable jobs can be estimated based on expanded generating capacities in renewable sources.

First, let's try to be very clear about what this is saying; we do not want to misunderstand. VCCER used the Chmura JobsEQ software to calculate the renewable jobs in hydroelectric and wind plants. Fine. The U.S. Energy Information Administration (EIA) indicates that there was no significant wind generation in Virginia in 2012. (We do not know what JobsEQ says on this point, but we will go with EIA.) This means that the 90 jobs in "renewable plants" were in hydroelectric facilities. To restate in plain English, there were 90 jobs in the operation of hydroelectric dams in Virginia in 2012.

The next sentence states that renewable electricity generation in Virginia was 2.36 gWh in 2012. EIA lists 1.04 gWh of hydroelectric output, zero solar PV, zero wind energy, and 1.44 gWh from biomass (a renewable fuel). Thus, EIA lists 2.48 GWH for renewables in 2012 (pretty close to what VCCER assumes). Unfortunately, since JobsEQ was not queried for employment in the burning of biomass, the VCCER study incorrectly left all of those jobs out of the estimate of jobs in renewables. So, they use hydro and biomass to calculate generation for the numerator but only hydro jobs in the denominator. The corrected calculation (1,040,000 kWh in hydro/90 jobs in hydro) shows that each renewable job in hydro is associated with 11,555 kWh. *It follows then that this key input for evaluating scenario economic costs and benefits due to employment changes is wrong by about half just due to this one error.*

Of course the kWh/job ratio in hydroelectric dams is not likely to be a good estimate for the ratio in biomass, wind, or solar PV. In fact, these renewables generation

[2] The reader should keep in mind that this analysis is not about the cost of generating electricity with renewables. Those direct production cost estimates are taken from Department of Energy figures. The issue here is the follow-on economic effects of changes in employment: losses in coal jobs versus gains in other jobs. So overestimating the kwh/job in renewables, as VCCER does here, makes the job losses from coal look much worse than they really are.

technologies will be much more job intensive than operating a completed hydroelectric dam. The Department of Energy data used for Table 8-1 of the VCCER report indicates that conventional hydro has the lowest fixed operations and maintenance costs of all energy sources except for certain new natural gas plants. *For non-hydro renewables, these costs, which include labor costs, are considerably higher, in fact, two to three times higher.* The kWh per job will be accordingly lower, driving the jobs figures for renewables in the compliance scenarios up by large amounts. The reader can see this in Table 8-1, which lists the costs of various energy sources. So, if we take VCCER at its word as to how it calculated renewables jobs effects, then all of the economic impact figures are *wrong by much more than half*.

A smaller additional point, while the VCCER report is unclear on this point, it appears that investments in transmission infrastructure are not included in the generation per job calculation, and yet, Table 8-1 indicates that investments in transmission infrastructure are more than three times greater for renewables than for central generation facilities, including conventional hydro. While this error is relatively small in magnitude compared to some of the other errors, it works in the same direction and is additive. It does not offset earlier errors, it adds to them.

This is not an issue of whether VCCER used the right methodology. It is a question of whether it used its chosen methodology correctly. It apparently did not. It made large errors that propagate throughout its analysis. Everything that follows and uses these estimates, is completely wrong.

Using the i/o multiplier: In the section titled "Employment Impact on the Fuel and Energy Efficiency Sectors," the VCCER report gives the following description of the i/o model results:

> As Table 8-13 shows, under the scenario where all coal-fired plants are retired (Scenario 5), Virginia coal mining industries would lose 3,305 jobs, or approximately 70 percent of direct coal mining jobs (2012) in Virginia. Based on typical indirect and induced employment multipliers for coal mining jobs of about 4, this would potentially create indirect and induced job losses of over 12,000 jobs, for a total of over 15,000 jobs impacted. Although other scenarios in this study implied less severe impacts, a significant portion of coal-mining employment nevertheless will be lost under all scenarios. Since 98 percent of Virginia coal mining employment is located in southwest Virginia, almost all jobs lost in the coal industry will be located in the Southwest Region.

This passage yields yet another apparent mistake, if we can trust the language in the quote. When you use an i/o model to estimate an effect, the total effect is the size of the original effect times the multiplier ***inclusive.*** That is, the original effect is included in the total effect. So adding back in the original effect after applying the multiplier is to double count it. To be specific, if the multiplier is 4, then the total effect is 3,305 times 4, including the initial effect, so here: 13,220. VCCER authors added to this the original 3,305 to get their total. This would be double counting the original effect. So right here we have a 25 percent overstatement of coal job losses. We do not know

whether this mistake is from the Chmura study or originated with VCCER, since we have not been given access to the Chmura study.

As for the multiplier used, this is not consistent with the standard IMPLAN multipliers for the coal industry in Virginia. We calculate the coal industry multiplier to be 2.6, not 4. The electricity industry multiplier is 3.6, but this is not the coal industry and it is quite obviously not a good substitute for the coal industry. This choice of multipliers requires a very clear justification, unless it is just an unfortunate mistake in using the wrong industry. *The multiplier used is a full 35 percent higher than those calculated using the industry standard IMPLAN model.*

There is a possible additional error of double counting, but we cannot be sure given the sketchy description of the Chmura study in the VCCER report. The first section of the description of the economic impact analysis (starting on page 162) deals with employment and cost effects on the electricity industry. The fuel and efficiency sector section (starting page 168) calculates effects on the coal and energy efficiency sectors, which are affected by changes in the electricity sector described earlier. So it is very likely, given the description available, that some of the effects measured in the earlier section are counted again in the fuel and efficiency sector part of the report. Again, not having access to the original Chmura study cited in the VCCER report, we cannot know whether the authors actually did make the mistake. It just appears so from their description. As with virtually all of the other mistakes, this would overstate the economic effects of compliance.

The choice of methodology:

Given the huge mistakes made in implementing this i/o analysis, it may seem pointless to criticize the methodology itself, but VCCER makes a vigorous defense of their use of the model, so we will point out some of the reasons why a simple, static i/o model such as the one applied here, cannot give good economic impact estimates in cases such as this one.

One of the main defenses in VCCER's reply is that i/o models are the best models we have available, so we should use them until another model comes along. Unfortunately, we have known since the 1970s that the standard i/o model is not appropriate for cases such as the one modeled here and will often give consistently biased answers (Miller and Blair 2009; see chapters 9, 10 and 14). As a result, many new techniques have been developed to correct some of the weaknesses in these models. *That there was not the time, expertise, or money to develop a better model does not make the old-style model any more correct.*

<u>Changing economic relationships:</u> As we have already described, i/o analysis relies on a set of fixed coefficients, each of which measures a stable relationship between two sectors of an economy estimated at a particular point in time. So, for example, how much coal is used to generate a kilowatt of electricity, how much of various categories of labor are used to produce coal, how much electricity is used to heat homes, and so

forth. Our emphasis here is on the word fixed. This relationship is based on data for an economy for a particular point in time and is determined by all of the characteristics of the economy at that time. It is essentially the current combination of technologies and relative prices that determine i/o coefficients.

One of the key limitations of this technique, and a limitation that has been understood since i/o modeling was first used, is that, if something happens that changes technologies or relative prices, these coefficients will change. If the price of oil goes up, people will substitute away from oil and will change the i/o coefficients for oil and for its substitutes. If technology changes, i/o coefficients will change. This implies that a policy experiment with an i/o model becomes less and less correct the greater the changes in prices and technology. The longer the time period over which you apply your experiment, the more the economy will respond and the more the coefficients will change.

Natural gas prices provide a prime example. As the price of natural gas began to fall relative to coal after 2008, power companies shifted both dispatch and investment away from coal facilities toward natural gas. This shift, has caused a continuing shift of inputs to electricity generation away from coal toward natural gas. On the renewables side, both declining costs and renewable initiatives have led to an increased share of renewables in the electricity sector. These shifts are transforming the i/o relationships in the energy sector, including changes in the relative share of expenditures on transmission as well as fuels.

In the current case, expected or induced changes in technology will cause the i/o coefficients to change in important ways. Take the case of energy efficiency. A policy that promotes spending money to improve energy efficiency is a policy specifically intended to change the relationships between various economic activities and the amount of energy used in those activities. The advent of led lights is apropos. Just since 2012, led light fixtures have moved into the mainstream. They are now used in homes, businesses, and on city streets. Led lights cause a substantial shift in the electricity used per square foot of commercial buildings, homes, and streetlights. Even without a policy, this will change the i/o coefficients. With a policy, the shift may be faster and greater. Hold this constant and you overestimate the cost of compliance.

A policy that proposed to change heat rates is specifically targeted to accomplish a reduction in the amount of coal needed to produce a kilowatt of electricity. Hold those coefficients constant, as the VCCER study does, and you have overestimated the cost of compliance.

VCCER specifically states that they expect a reduction in the price of coal. A policy change that lowers demand for coal in the domestic electricity sector will lower the price of coal, which, in turn, will increase the quantity of coal demanded either for export or for use in other sectors. This implies a change in i/o coefficients. If this price change were very small and the time period very short, we might be able to assert with some justification that the error would be small relative to other effects of the

policy. But that is clearly not the case here where there are large changes taking place over long periods of time. The errors can no longer be assumed to be small.

Because of the large effect on the demand for labor that is assumed in the VCCER study, it is worth spending some extra time examining what happens in the labor market if there is a reduction in the demand for coal, keeping in mind, of course, that the actual fall in quantity demanded will be less than the initial assumed amount because of the consequent reduction in price.

Suppose that coal production falls just enough so that 100 people lose their mining jobs due to a substitution of imported natural gas for domestic coal. The standard i/o model used here eliminates all of the economic activity associated with those 100 people. Not only are those people unemployed, they no longer have any economic role in the state's economy. This initial effect then ripples through the economy because of the lost spending by those people. But, generally, this is not what happens, either in the short or long runs.

In the short run, some workers retire early, some go on unemployment, some move to other parts of the state. (Some workers do pack up and move to another state, but, since the CPP is a national regulation, and since Virginia's reductions are not likely to be any more costly than for surrounding states, out migration of all of these workers is very unlikely.) The retired workers take a pension or spend retirement income (some Social Security), which means that the reduction in economic activity is measured not by the worker's coal mining income but by the difference between their coal mining income and their retirement income, this difference being a much smaller quantity than total mining income.

To the extent that workers stay in the state, the lower demand for workers implied by the loss of the 100 coal mining positions will tend to push wages lower in the short run. This is costly for the worker, but it is actually good for employers, because their labor costs have fallen. The cost to society of the shift from the coal mining job to another lower wage job is not correctly accounted for by the i/o model as applied here. Assuming that all workers lose their jobs and do not ever work again is likely a substantial overestimate even in areas with high rates of unemployment. What is more, if a worker dips into savings for some education to raise his or her productivity and increase potential earnings, the expenditure on education needs to be added to economic activity in the short run and the higher worker wages in the longer run. Again, this is activity is not accounted for in an i/o model.

Transfer payments such as unemployment insurance, Social Security, Medicaid, pension payments, and job re-training programs reduce both the short and long run effects of job losses. All reduce the magnitude of the follow-on consequences of the initial job loss. No one is arguing that we should have increasing these transfers as a policy goal in itself, but, if we want to know the economic consequences of a change in economic fortune in some industry, we must take transfer payments into account.

On the production side, the coal industry also responds. A fall in the domestic quantity demanded for electricity generation leads to a reduction in price. This reduction in price makes the coal more competitive both for other uses, say metallurgy, and for use abroad. Plus, the fall in coal prices makes electricity cheaper to generate, reducing the cost of electricity to consumers. It is possible, if unlikely, that the price of coal would *not* fall, in which case, the i/o coefficients for the coal industry would apply. But if the price does respond, then the i/o multipliers would overestimate the economic response of the coal industry (and of coal employment) to the change in the domestic quantity demanded.

The unresponsiveness of i/o model coefficients to changes in the economy is well understood. Modern versions of i/o analysis build some responsiveness into the model. The model used in this study did not make any attempt to adjust for changes in prices or technology. For a large policy change such as the one modeled here, i/o estimates of economic impact are particularly untrustworthy without accounting for these "equilibrium responses". This is especially important here, given the lengthy time horizon and the changes that we expect to occur over that period in prices and technology.

Miscellaneous

VCCER made multiple, serious mistakes in calculating the "Benefit from reduced social cost" estimates, although the magnitude of this error may be lower than our original estimate.

In our original analysis, we claimed that VCCER double discounted the SCC before adding it to the benefits measure. Their discounting mistake, *and they clearly did make a discounting error*, did not cause as large an error as our earlier estimate. In fact, the mistake amounted to a 12.5 percent understatement of benefits rather than a 40 percent understatement.

Since the VCCER authors persist in claiming what they did was correct, even though it is plain from the text that it is incorrect, we will go through their benefits estimates step by step. First, we quote the last paragraph of page 177 in its entirety:

> Using a 3 percent discount rate, the EPA estimates the global SCC for CO2 emissions as averaging $39/metric ton in 2015; $46/metric ton in 2020; and, $55/metric ton in 2030. Discounting the 2015 value to 2012 yields an SCC for Virginia's CO2 emissions of $36/per metric ton or approximately $940 million in that year (EPA, 2014g). Using the estimated CO2 emissions in 2030 under Scenario 6, which corresponds to EPA's Option 1 and requires an emissions rate of less than 810 tons of CO2 per megawatt hour, the projected SCC in Virginia is approximately $780 million, a reduction of $160 million.

In the first sentence, the authors describe how they take EPA's social cost of carbon (SCC) estimate for 2015 and discount it from 2015 to 2012. So, they are describing the process of taking numbers expressed in 2015 dollars and expressing them in 2012 dollars. What they have missed, and still to not acknowledge in their reply, is that the EPA SCC figures are already expressed in 2011 dollars. We copy the table from EPA's RIA here so that the reader can see this:

Table 4-2. Global Social Cost of CO_2, 2015-2050 (in 2011$)*

	Discount Rate and Statistic			
Year	5% Average	3% Average	2.5% Average	3% (95th percentile)
2015	$12	$39	$61	$116
2020	$13	$46	$68	$137
2025	$15	$50	$74	$153
2030	$17	$55	$80	$170
2035	$20	$60	$85	$187
2040	$22	$65	$92	$204
2045	$26	$70	$98	$220
2050	$28	$76	$104	$235

* The SCC values vary depending on the year of CO_2 emissions and are defined in real terms, i.e., adjusted for inflation using the GDP implicit price deflator. These SCC values are stated in $/metric ton.

So, by discounting the 2015 SCC estimate from $39 to $36, what they have actually done is to take a value that is given in 2011 dollars and discount it by 3 years at about 3 percent, which, by the way is more than the average rate of inflation during this period. Now, the figures are given in their version of 2008 dollars although the authors appear to be under the impression that the values are expressed in 2012 dollars and, in fact, add these values to other values expressed as 2012 dollars. (See Table 8-23.)

In our original evaluation, we assumed, based on what little description was provided, that the authors were discounting from the year of the SCC value to the present. This was not correct. This was only true for the 2015 value. Instead, what they apparently did, and we have to infer here, is to discount **all** values by three years at 3 percent. So, for example, instead of **double** discounting all of the values, they only fully double discounted the 2015 values. All values were discounted incorrectly by 3 years, putting all estimates in something like 2008 dollars and making the values appear smaller than they should have been. *We will show this using the VCCER figures* from the paragraph quoted above, but they make the same error in the construction of Table 8-22.

Given the $36 value for SCC and the total SCC figure of $940 million, we can calculate that VCCER is using 26.11 million tons as their CO_2 emissions figure for 2012. [We could not find this figure explicitly stated anywhere in the study.] According to the authors their 2030 emissions under Scenario 6 are 15.57 million tons. If the total damages from these emissions are $780 million (as stated) then this gives a cost of $50.09 per ton. But the value that EPA gives for the SCC in 2030 is $55 per ton

(measured in 2011 dollars, as we have noted). The VCCER figure is what you get by discounting $55 by three years at 3.1 percent.

In each case, the correct procedure would have been to *inflate* the EPA values by one year to put the values in 2012 dollars rather than the original 2011 dollars. The result was about a 12.5% understatement of the social cost of carbon just from the discounting error alone.

It appears that this same mistake was repeated on pages 178 and 179 where the authors claim to be using "another monetized metric" of the SCC from EPA. We have already demonstrated that these calculations are based on a misunderstanding of the EPA RIA. Since the authors persist in claiming that they have not made a mistake, we will explain again what they have done wrong. We start by reproducing here Table 4.3 from the RIA, which comes immediately after Table 4.2 reproduced earlier:

Table 4-3. Estimated Global Climate Benefits of CO_2 Reductions for Proposed EGU GHG Existing Source Guidelines in 2020 (billions of 2011$)*

Discount Rate and Statistic	Option 1 – state	Option 1 – regional	Option 2 – state	Option 2 - regional
Million metric tonnes of CO_2 reduced	383	371	295	283
5% (average)	$4.9	$4.7	$3.8	$3.6
3% (average)	$18	$17	$14	$13
2.5% (average)	$26	$25	$20	$19
3% (95th percentile)	$52	$51	$40	$39

* The SCC values are dollar-year and emissions-year specific. SCC values represent only a partial accounting of climate impacts.

This table is calculated by taking the tons of CO_2 reduced and multiplying them by the SCC for the appropriate year. So, for example, taking the column "Option 1 – state", which the VCCER authors use in their report, the row labeled "3% (average)" is simply the value 383 (tons reduced) multiplied by the SCC for 2020 ($46) to give $18 billion 2011 dollars (it is rounded up from 17.6). The original VCCER report mistakenly claims that this is a separate method for calculating the global benefits of reducing CO_2 emissions. *It is most obviously not.* It is merely a combination of the SCC estimate just given with the estimate of the number of tons each strategy would be expected to reduce.

The VCCER authors go through a set of calculations to estimate out Virginia's share of this data and then presents it as if it is somehow different from the calculations described at the bottom of page 177. The only difference is that the page 177 calculations use VCCER's estimates of emission reduction costs in Virginia and the page 178-179 calculations use an approximate method to back out estimated reduction costs from EPA estimates. The VCCER authors then misapply their discounting method to the results, incorrectly reducing each of the values by about 12.5 percent.

It seems obvious from the text that the calculations on pages 177-179 were used to

construct the "Benefits from reduced social costs" column in Table 8-23. But it is not clear how this was done, since the report says only: *Table 8-23 combines the costs and benefits discussed above.*

Focusing on Scenario 6 in Table 8-23, the benefit figure given for reduced social cost is $95 per ton of CO_2 reduced. This can't be due to health effects, since those are listed separately. The text on page 177 implies a SCC estimate of $50.09 in 2030 for Scenario 6, as we have already described. Where, then does the extra $45 in social costs of carbon come from? It can't be from the second "monetized metric" calculations at the top of page 179, that value is $50 per ton reduced. And besides, it would be perfect double counting to add these two measures together.

There is some truth, then, to the VCCER authors claim that we can't understand what they did. They develop what they believe to be two separate measures of the social cost of carbon, both right at $50 per ton. Then they report a value of $95 per ton in the table of results. We do understand the mistakes they made in their calculations leading up to Table 8-23, but we failed to find anywhere in the report a description of how they combined these incorrect numbers to get the results they reported.

VCCER claims that, since the building of North Anna 3 isn't certain, it should not be considered in compliance scenarios.

Here is the only rationale given by VCCER for leaving out a North Anna 3 (NA3) scenario:

> At the time of our study, Dominion Virginia Power's most recent Integrated Resource Plan (filed with the Virginia State Corporation Commission and dated August 29, 2014) discussed the potential for a new nuclear unit at their North Anna site (see section 5.3 of their plan, page 71).
>
> - The Company stated "it is in the process" of developing a new nuclear unit at its existing North Anna Power Station
> - The process is contingent upon obtaining all the required permits and licenses (COL) and also Nuclear Regulatory Commission approval of the withdrawal of Old Dominion Electrical Cooperative from any Unit #3 participation.
> - Dominion now determines that the "earliest" possible in-service date for a North Anna unit #3 would be September 2027 with this capacity being available to meet summer peak demand in 2028.
> - "The company states it *has not committed* to build North Anna 3 and will not make a final decision until after the issuance of the COL" (by the NRC). [emphasis added by VCCER]
>
> Due to these considerations regarding North Anna Unit #3, the VCCER team and the other state agencies preparing the Virginia Energy Plan concluded it was not prudent to include the addition of new nuclear capacity in the compliance analysis.

These bullet points amount to the assertion that since the building of NA3 is not certain, we should not consider it as a possible compliance scenario. This, in spite of

the fact that the very same Integrated Resource Plan VCCER uses in this quote claims the NA3 route as Dominion's *preferred* resource plan.

VCCER gives an excuse, not a reason. ***All compliance scenarios are speculative.*** The licensing of NA3 could hardly be seen as any more speculative than any of the other highly speculative compliance scenarios chosen by VCCER.

The important fact here is that, should NA3 be built by Dominion because of its attractive properties for the state's electricity supply (as Dominion asserts in its IRP), then it would represent a *zero compliance cost option* because its costs would not be attributable to the CPP and yet the state would end up in compliance as a result. Costs would actually be less than zero due to the opportunities to sell emission reductions to other states. This absolutely belongs as a compliance scenario, otherwise state decision makers will have an incomplete picture of their compliance options and the likely costs.

That VCCER did not include a NA3 scenario is a glaring defect in the information provided to policy makers.

VCCER authors still seem not to understand that by ignoring multi-state solutions, they overestimate compliance costs.

If the objective of the report was to give realistic measures of compliance costs, then VCCER should have noted that the cost estimates were very likely exaggerated, since the estimates they present implicitly assume no multi-state compliance arrangements. This issue has been under discussion in the literature, since before the development of this regulation began. There is no excuse for ignoring it and the likely effect it would have on lowering compliance costs. This is one of the most glaring failures in the original report and the authors have done exactly nothing to adjust or correct for it. State-by-state autarchy would be a self-destructive approach. To willfully ignore this is to willfully ignore an essentially universal conclusion by academics, industry, and private consultancies. *VCCER should have clearly and unequivocally stated that their estimates were most likely too high because of their unwillingness or inability to model interstate compliance.*

VCCER stands by its mischaracterization of the GAO report on EPA use of SCC estimates and cites pro-coal interest groups in its own critique of the SCC.

VCCER clearly mis-uses the GAO report for rhetorical ends. Here is the quote:

> It should be noted that the Government Accountability Office and a number of other entities have criticized the EPA's methodology (GAO, 2014).

The wording in the original VCCER report was clearly intended to imply that the GAO had accused EPA of doing something inappropriate. This is wrong, and any fair reader of the GAO report can easily see this. In our original report, we demonstrated with

quotes directly from the GAO report, that the GAO vindicated EPA of misuse of the SCC. GAO very specifically states that EPA did what was recommended by current federal agency guidelines. VCCER provides no defense on this point whatsoever. If VCCER does not like the value used for the SCC, then it is the Interagency Working Group on Social Cost of Carbon it needs to mention as responsible for the estimate.

The Interagency Working Group on Social Cost of Carbon was convened by the Office of Management and Budget under Executive Order 12866. Member agencies included the Council of Economic Advisers, the Council on Environmental Quality, the Department of Agriculture, the Department of Commerce, the Department of Energy, the Department of Transportation, the Environmental Protection Agency, the National Economic Council, the Office of Management and Budget, the Office of Science and Technology Policy, and the Department of the Treasury. *Again, the GAO specifically stated that EPA used the appropriate guidelines available at the time it drafted its RIA.*

The quote above also suggests that there are credible critiques of EPA's use of the SCC and, yet, the authors can only manage to quote three pro-coal advocacy groups in support of their position. There is much careful academic work attempting to make sense of how the global SCC should be estimated and used. **VCCER ignored the published, peer-reviewed studies in this area and simply cites pro-coal advocacy groups.** The citations given are from the American Coalition for Clean Coal Electricity, the Institute for Energy Research, and the U.S. Chamber of Commerce. The first two are comments on the OMB docket concerning the development of the SCC. The third is just a general brochure on regulatory burdens from the Chamber. This can hardly be said to provide a balanced analysis of SCC issues. That these are the only support VCCER can give for its oblique reference to *other entities* critical of EPA, speaks volumes.

A perfectly valid way of proceeding, would have been to review the spread of SCC estimates in the published literature (even include coal industry advocacy groups, if their work is of sufficient quality or is subjected to academic peer review) and provide a few separate estimates of CPP benefits using different levels of the SCC. EPA did this in its RIA. As it is, VCCER used a figure for the SCC that it miscalculated due to a simple arithmetic error. (discussed above).

How the SCC should be used in assessing state benefits of national controls on greenhouse gas emissions is an interesting policy issue all by itself, although VCCER does not raise this issue as best we can tell.

The VCCER report mixed short tons and metric tons.

See Table 8-23. The figures in the “Increased [c]ost to utilities” column are from Table 8-3 and appear to be listed there as “short tons”, while the “Benefits from reduced social costs” column is in metric tons. The difference between the measures is about 10 percent.

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