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Comments on: The Cost and Impact of a 100% Renewable Energy Portfolio Standard for the State of Colorado, a study by *Energy Ventures Analysis* commissioned by and based on guidelines supplied by the Independence Institute.

BACKGROUND: WHAT IS THIS DOCUMENT?

The *Independence Institute* is a libertarian organization in Denver, Colorado. This Institute has established itself as the most vocal opponent of renewable energy in Colorado. In 2017, The Independence Institute commissioned *Energy Ventures Analysis Inc. (EVA)*, a Washington, DC based energy consulting firm to estimate the cost of switching Colorado to 100% renewable electricity by 2040. *EVA* has also recently prepared a study for Peabody Coal opposing the retirement of the Navajo coal power plant in Arizona. The 100% renewables study for the Independence Institute, discussed here, formed the basis of multiple interviews and articles from Amy Oliver Cooke, the Director of the Energy and Environmental Policy Center for **the Independence Institute**. Cooke is on record for her disbelief in climate-change science and continuously disseminates claims that CO₂ emissions are beneficial for the planet ([here](#)).

This document identifies the key assumptions in **EVA's** study of switching Colorado to 100% renewables by 2040, calculates the implications of these assumptions on actual costs, and assesses the consistency between the **EVA study's** cost estimates and the interpretations of the **EVA** study provided by representatives from the Independence Institute. While the **EVA** study included two scenarios, one for building actual renewable power plants and another for using renewable energy credits, these comments will focus on the case of building renewable power plants.

DOES THE EVA STUDY SHOW THAT RENEWABLES ARE MORE EXPENSIVE THAN THE BUSINESS-AS-USUAL CASE WITH COAL, GAS, AND EXISTING SOLAR AND WIND?

No. The **EVA** energy-cost study does not include a calculation of the business as usual case, so no conclusion can be drawn. The full study can be found [here](#).

WHAT DOES THE EVA ENERGY-COST STUDY DO?

The EVA study estimates the total capital cost for Colorado to achieve 100% of its electricity from solar & wind by 2040. No calculations were done for the costs of any other power plant scenarios.

WHAT WERE THE KEY ASSUMPTIONS IN THE EVA ENERGY-COST STUDY?

Following are four key assumptions in the EVA study:

1. The scenario that they construct does not take strategic advantage of federal solar and wind tax breaks that are available through 2022.
2. The costs of renewables includes paying off the existing debt on fossil fuel plants that are retired. These costs are accelerated to be due prior to 2040.
3. The capital costs for all renewable energy production facilities are paid in cash by 2040 instead of being paid over the life of the power plant as would be normal practice.
4. Colorado is an energy island, and can't import or export electricity. This assumption increases costs since excess renewable power is wasted when supply exceeds demand (rather than selling it to another state). Also, we need to build overcapacity rather than buying power from other states as required to meet demand shortfalls. This contrasts with, for example, the Southwest Power Pool, or the California Energy Imbalance Market. Both of these work across state lines to lower costs of electricity using both geographic and demand-curve diversity.

The choice of each of these particular boundary conditions for the study maximizes the apparent capital cost of switching to 100% renewable energy by 2040.

ACCORDING TO THE EVA STUDY, WHAT WOULD IT COST TO REACH 100% RENEWABLE ELECTRICITY IN COLORADO BY 2040?

Using the assumptions described above, EVA estimated that building the solar and wind power plants sufficient for 100% renewables by 2040 would cost 45 billion dollars. This includes battery storage, plus paying off the debt for the existing fossil fuel plants (7.6 billion dollars).

HOW HAS THE INDEPENDENCE INSTITUTE PRESENTED THE COST ESTIMATES FOR SWITCHING TO RENEWABLE ENERGY IN THE EVA REPORT?

In interviews and op-eds, Independence Institute representatives, citing the cost estimates in EVA's report, stated that the cost for switching to 100% renewable electric energy in Colorado by 2040 are: "fiscally irresponsible", "morally repugnant", "would result in "chopping that median income [of a family of four] in half for more expensive, less reliable power", and would cause "daily rolling brownouts and blackouts". A plan to achieve this would be "crazy, crazy, crazy" and would "out crazy California". An interview with Amy Oliver Cooke regarding this study can be found [here](#). These interviews took the big number constructed by the EVA, 45B\$, and failed to mention how this might compare to the costs in any other scenario. In the third quotation above, this cost was presented as being "due" in a single year while failing to mention that this number would be an *alternative* to the prepaying a lump sum for the costs of the existing power system and fuel for 25 years.

ARE THESE STATEMENTS MADE BY THE INDEPENDENCE INSTITUTE CONSISTENT WITH THE COST ESTIMATES IN THE ENERGY VENTURES ANALYSIS REPORT?

No. These statements are not supported by any of the conclusions in the actual report. Specifically, the EVA report:

- 1) makes no calculation for the costs of the existing electric energy system of coal, gas, wind, and solar, so there is no basis for comparing the cost of the 100%-renewable electricity scenario with the cost of a Business as Usual (BAU) base case; and
- 2) includes no data on the reliability of renewables relative to the reliability of a BAU case.

The total cost of renewables in these interview is incorrectly interpreted as "extra costs" that would be billed to the customer. In actual fact, these costs would be instead of the costs of running the existing power plants including the costs of fuel. Whether or not these costs are more or less than any other plan, including a fossil-fuel future, is not addressed in the study.

IN A COMPARISON OF COSTS FOR POWERING THE COLORADO GRID THROUGH 2040, HOW DOES THE ENERGY VENTURES ANALYSIS ESTIMATE COMPARE TO THE BUSINESS AS USUAL (BAU) CASE?

Using the same rules as in the Energy Ventures report (which were checked through correspondence with the analyst), I find that the BAU case using the same mix of fossil fuel and renewables that we have today would cost about 43 Billion dollars over the 23 years until 2040. This is about the same as they calculated for 100% renewables. The Energy Ventures methodology used for renewables is unorthodox in paying for power plants up front rather than over their design life. The best approximate comparison for fossil fuels, made here, is to count the remaining debt payments, new power plant costs before 2040, and fuel, operations, and maintenance until 2040. I used Xcel numbers for fuel and O&M costs with a weighted average for coal and gas*. For fossil fuels, the fuel and operations costs greatly exceeds the initial cost of the power plant to make up the major costs of electricity. Fuel costs are completely ignored in the EVA study.

WHAT WOULD THE COST OF SWITCHING TO 100% RENEWABLE ELECTRIC ENERGY BE IF COLORADO TOOK MAXIMUM ADVANTAGE OF THE TAX BREAKS IN THE FEDERAL LAWS?

The costs for the renewables scenario could be as low as 34 billion dollars. This would be a lower bound for the same plants in the EVA study but building out ASAP under the existing federal production and investment tax credits. Additionally, there are choices that could be made in the renewables portfolio that could also lower the costs further, such as changing the ratio of wind, utility solar and rooftop solar, or allowing sales across state lines so that the grid could be balanced using lowest cost renewables. The variability of the renewables would be less due to a larger geographic area reducing the need for storage. That is, Colorado could sell renewable electricity to other states when we had excess, and buy renewables electricity from other states when we needed it. Of course, the costs of fuel for wind and solar are free in comparison to the fossil fuel plants. Lastly, the costs of renewables is rapidly decreasing with time so the actual costs of renewables are already lower than assumed in the EVA report.

THE INDEPENDENCE INSTITUTE INTERVIEWS INCLUDE DIRE ESTIMATES FOR LAND USE UNDER A 100%-RENEWABLE-ENERGY SCENARIO, WITH WIND TURBINES EVERYWHERE ACROSS COLORADO'S FRONT RANGE. ARE THESE TRUE?

The area estimates for the wind farms in the report are based on existing wind farms and are reasonable. The verbal depiction of windfarms in the front-range cities in the interviews is not true. For example: "Imagine the metro area going up into the foothills covered with wind turbines". "Anyone who has a view of the mountains would be looking through wind turbines." These statements are huge exaggerations.

As noted in the report, the best wind resources are in Eastern Colorado near the Kansas and Wyoming borders, not in the area from the metro area going into the foothills. Xcel

currently has about 27% renewables on the grid. Extending to 80%, for example, might involve installing wind turbines at the same rate we have in the last 12 years for the next 24 years, primarily in rural eastern Colorado. We already have one-third of the wind turbines that we would need.

Xcel recently had a request for solar and wind renewable proposals (found [here](#)). The resulting proposals total to two or three times more renewable power than we might need for a 100% plan. This indicates that the rural property owners where these wind farms would be located are interested in becoming part of the clean-energy economy to benefit from money being spent in rural CO.

WHAT CONCLUSIONS CAN BE DRAWN FROM THE INDEPENDENCE INSTITUTE'S MEDIA RELEASES AND THE STUDY THEY COMMISSIONED FROM EVA ON TRANSITIONING TO RENEWABLE ENERGY IN COLORADO?

The EVA study provides a simplistic cost estimate, as specified by the Independence Institute instructions. EVA used assumptions that tended to maximize the apparent cost of switching to renewables and completely ignored the savings from NOT buying coal or gas to burn in power plants. The Independence Institute's public statements were constructed to be deliberately misleading overstating the apparent cost for renewable energy. As a result, the Independence Institute's public statements don't contribute to a useful discussion of Colorado's future electrical energy supply. In the Amy Cooke interviews with the Heartland Institute, and then on TV with the "Devil's Advocate", even the interview hosts seem confused or deceived into making wildly nonsensical claims about the costs of renewable energy plans for Colorado. Certainly there are real technical challenges in the details in implementing a 100% renewable plan, especially as we approach 80-100% towards 2040. The report and interviews did not address these real issues. These interviews are at odds with the available evidence that renewables are now comparable or less expensive in price compared to conventional power plants in Colorado. An EIA analysis with maps is shown [here](#). The trend towards renewables is accelerating for cost as well as environmental reasons.

Update: In September 2018, the Colorado Public Utility Commission ruled on a plan for Xcel, which provides a majority of Colorado electricity, to shift from 27% to 55% renewables by 2026. It was found that retiring 2 coal plants and replacing with renewables would not increase the costs at all, actually saving money. This contradicts the Independence Institute takeaway from this Energy Ventures study that 100% renewables would "cost 45B\$" by showing that the first 1/3 of the transition is at no additional cost. The Independence Institute intervened in the legal proceedings for these PUC hearings. However, nothing from this Energy Ventures report was used by the Independence Institute in this technical setting where assertions could be challenged by experts and by

the PUC itself. At one point, the expert witness for the Independence Institute argued that the coal plants should be replaced by lower-costs renewables upon closure.

Disclaimer: All of these numbers are approximate.

All numbers discussed here need to be taken with a grain of salt. A full utility analysis of cost and benefits including reliability is far more complex than the simplistic scenario in the EVA report prepared for the Independence Institute and the back-of-the-envelope approximations made here.

*I estimated 24.3\$/MW-hr for fuel and O&M costs based on a 70/30 mix of coal to gas and the numbers in Xcel PUC testimony (Fig. JFH-4 Proc. 16A-0396 pg. 46). 2GW of fossil fuel power plants that are scheduled for retirement (mostly coal) before 2040 were replaced at the overnight capital costs of the cost of coal plants, 4.88\$/W from the EIA Annual Energy Outlook based on the Rocky Mountain Power Area (RMPA). The debt on existing fossil plants was the same as in the Energy Venture Analysis report, 7.6 Billion \$.