The Colorado Energy Plan:
Economic Value of Health Benefits from Colorado's Renewable Energy Future

Air pollutants from fossil fuel-based energy like coal can exacerbate respiratory illnesses like asthma and bronchitis and increase the risk of heart attacks. Poor air quality can impact more than an individual's physical health through externalities, or additional costs, including lower productivity or lost wages from missed days of work or school, medical treatment costs, and reduced quality of life from outdoor activity restrictions. Xcel Energy's Colorado Energy Plan has the potential to significantly reduce air pollutants in both Pueblo County and Colorado, which in turn results in cost savings in health care spending. The reduction in air pollutants achieved in the Colorado Energy Plan could mean as much as $7.8 million for Pueblo County and upwards of $95.2 million for the state of Colorado. Moreover, better air quality leads to better quality of life, and translates to greater worker productivity and economic activity.

Impacts

The Colorado Energy Plan proposes retiring two Pueblo-area coal-fired power plants, Comanche 1 & 2, ten years early and replacing the lost capacity with renewable energy—primarily wind and solar. The implementation of this plan would likely result in lower emissions and fewer harmful air pollutants, leading to improved air quality. The purpose of this analysis is to quantify the number of health incidents likely to be avoided and the corresponding economic value that could result from the improved air quality in Pueblo County and Colorado from implementation of the Colorado Energy Plan.

Both the Colorado Energy Plan and Governor Hickenlooper's Executive Order D 2017-015 use 2005 as a baseline for determining emission reductions in a given year. For this reason, we estimated emission reductions for Pueblo County and the state from 2005 emission levels. The reductions are then used to model estimated health and economic impacts based on projected emission levels in 2017. The impacts were estimated for fuel combustion electric utility from coal only. Table 1 illustrates the estimated emission reductions:

Table 1

Pollutant	2005 Levels (Tons)	% Target	Estimated Emission Reduction (Tons)	2025 Baseline Pueblo, County (Tons)	2025 Baseline Colorado (Tons)
PM2.5 Primary	269.07	26%	69.96	595.48	2,906.27
SO2	13,443.00	90%	12,098.70	4,151.08	14,665.48
NOX	7,971.48	90%	7,174.33	5,203.61	22,966.74
NH3	40.35	26%	10.49	88.44	258.27
VOC	79.99	26%	20.80	176.89	514.89

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Table 2 shows the total economic value of health benefits; decreases in adult mortality, hospital or emergency room visits; asthma-related events; and missed days of school and work. In Pueblo County, there could be as much as $7.8 million in economic value because of better air quality and that number rises to as much as $95.2 million statewide. This is the economic value of the health incidents avoided from lower air pollutants:

Table 2

Location	Discount Rate	$ Total Health Benefits (low estimate)	$ Total Health Benefits (high estimate)
Pueblo	7%	$3,490,581.70	$7,890,383.59
	3%	$3,112,810.26	$7,034,347.02
Colorado	7%	$37,656,785.92	$84,972,752.72
	3%	$42,199,479.81	$95,279,931.23

The tables below illustrate the economic value of health benefits gained from improved air quality that results from a decrease in specific air pollutants as well as the number of health incidents avoided. For example, Pueblo County could see an increase in productivity of 33 additional work days with an economic value of over $6,000 in 2025 dollars and the could see 651 additional work days with an economic value of $116,000. The different discount rates used in these estimates allow us to determine to what extent, if any, different rates impact the outcomes. A higher discount rate is typically shows the

Health Incident Avoided Pueblo County	Economic Value $ 2025	
	3% Discount Rate	7% Discount Rate
Adult Mortality	$7,821,344.83	$6,966,347.41
Infant Mortality	$3,509.55	$3,509.55
Non-fatal Heart Attacks	$37,217.90	$36,178.75
Hospital Admits, Respiratory	$2,793.09	$2,793.09
Hospital Admits, Cardiovascular	$2,706.03	$2,706.03
Acute Bronchitis	$241.87	$241.87
Respiratory Symptoms	$440.62	$440.62
ER Visits Asthma	$52.81	$52.81
Asthma Exacerbations	$542.59	$542.59
Minor Restricted Activity Days	$15,500.38	$15,500.38
Work Loss Days	$6,033.93	$6,033.93

Health Incident Avoided Colorado	Economic Value $ 2025	
	3% Discount Rate	7% Discount Rate
Adult Mortality	$94,163,862.09	$83,870,253.90
Infant Mortality	$90,665.62	$90,665.62
Non-fatal Heart Attacks	$514,233.16	$500,662.84
Hospital Admits, Respiratory	$31,240.23	$31,240.23
Hospital Admits, Cardiovascular	$44,304.53	$44,304.53
Acute Bronchitis	$4,189.74	$4,189.74
Respiratory Symptoms	$7,613.98	$7,613.98
ER Visits Asthma	$950.82	$950.82
Asthma Exacerbations	$9,521.91	$9,521.91
Minor Restricted Activity Days	$296,633.14	$296,633.14
Work Loss Days	$116,715.99	$116,715.99

effect of investments with immediate benefits and has the effect of reducing the value of future benefits. We know with projects like the Colorado Energy Plan the benefits of improved air quality are short and long-term. The COBRA model indicates several of the estimates are the same for both the 3 and 7 percent discount rates. This is because a discount rate is only applied on the monetized value of adult mortality and nonfatal heart attacks. In both of these cases, the model estimates how changes in emissions affect health outcomes over a 20-year period. Adult mortality accounts for the majority over 95 percent of monetized health impacts. All of the other health outcomes are estimated in a single year. Discount rates do not impact the number of health incidents avoided only the economic value of those incidents.

The Colorado Energy Plan, if implemented, has the potential to significantly reduce air pollutants in both Pueblo County and Colorado. This analysis estimates changes in air quality and quantifies the economic value of estimated health incidents avoided to determine if the air pollutant reductions from Colorado

Pueblo County	Health Incidents Avoided
Adult Mortality	0.79
Infant Mortality	0.000316
Non-fatal Heart Attacks	0.27
Hospital Admits, Respiratory	0.09
Hospital Admits, Cardiovascular	0.06
Acute Bronchitis	0.44
Respiratory Symptoms	13.78
ER Visits Asthma	0.11
Asthma Exacerbations	8.29
Minor Restricted Activity Days	200.48
Work Loss Days	33.66

Colorado	Health Incidents Avoided
Adult Mortality	9.46
Infant Mortality	0.01
Non-fatal Heart Attacks	3.83
Hospital Admits, Respiratory	1.00
Hospital Admits, Cardiovascular	1.02
Acute Bronchitis	7.70
Respiratory Symptoms	238.14
ER Visits Asthma	1.99
Asthma Exacerbations	145.48
Minor Restricted Activity Days	3836.54
Work Loss Days	651.09

Energy Plan result in cost savings. The economic value attributed to these benefits can lead to long-term cost savings in health care spending. Overall, the likely improved air quality results in health care cost savings in both Pueblo County and Colorado. These benefits are important in the overall consideration of the Colorado Energy Plan.

Model

The Co-Benefits Risk Assessment Tool (COBRA) Health Impacts Screening and Mapping Tool, developed by the Environmental Protection Agency (EPA), estimates the health-related economic benefits from reductions in emissions or air pollutants that result from clean energy policies and programs.

The COBRA model estimates the following:

1. Changes in air quality resulting from changes in specific pollutants.
2. Changes in health outcomes.
3. Monetary values of those health outcomes.

The air pollutants used by the model to estimate changes include:

- Particulate matter (PM2.5)
- Sulfur dioxide (S02)
- Nitrogen oxides (NOX)
- Ammonia (NH3)
- Volatile organic compounds (VOCs)

For the purposes of this analysis, it is important to clarify that these are conventional air pollutants not greenhouse gases (GHG). For example, carbon dioxide is not estimated in this model because it is classified as a greenhouse gas and not a conventional air pollutant. Because the COBRA does not quantify ozone-related benefits, the results might be underestimated because they don't account for impacts from GHG emissions. COBRA is a screening model that converts air pollutant reductions into

changes in air quality and estimates the number of cases of illness and death avoided, as well as the economic value of those benefits to communities.

The health incidents and related economic value calculated by COBRA include:

- Non-fatal heart attacks
- Respiratory-related and cardiovascular-related hospitalizations
- Acute bronchitis
- Upper and lower respiratory symptoms
- Asthma-related emergency room visits
- Asthma exacerbations
- Minor restricted activity days (i.e., days on which activity is reduced, but not severely restricted)
- Work days lost due to illness

Assumptions

Baseline: The baseline is the year from which the model will estimate the health and economic impacts of air pollutant changes. COBRA includes baseline projections for 2017 and 2025. Because the Colorado Energy Plan expects to retire Comanche 1 & 2 by 2026, we selected 2025 as our baseline for the model.

Region: We modeled the air pollutant changes and corresponding health and economic outcomes, both in Pueblo County where the plants are located, and statewide.

Emissions Change: Xcel Energy expects the early retirement of Comanche 1 & 2 to reduce sulfur dioxide, nitrogen dioxide, and nitric oxide 90 percent below 2005 levels. However, Xcel's estimates only account for two of the five pollutants estimated in the model. To account for the remaining three, we used the targets set in Executive Order D 2017-015. Signed by Governor Hickenlooper in 2017, the order titled "Supporting Colorado's Clean Energy Transition" set emission targets at 26 percent below 2005 levels by 2025. This statewide target was used as the starting point to estimate emission reductions for the remaining air pollutants. Using 26 percent for the emission reductions helps maintain consistency for the estimates of each pollutant.

Discount Rate: COBRA allows users to run each analysis with a 3 or 7 percent discount rate (i.e. the calculation used to express future values in current terms). The EPA's "Guidelines for Preparing Economic Analyses" (U.S. EPA, 2010a) recommends calculating monetized health benefits using both discount rates to evaluate whether (and to what extent) the overall outcome of the analysis is affected by the choice of discount rate. Both 3 and 7 percent were used as discount rates in this analysis; however, the COBRA model also notes that a higher discount rate favors investments with immediate benefits and reduces the value of future benefits more than a lower discount rate, which places greater value on future benefits to communities.

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