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Case study of the energy transition: Pueblo, Colorado

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ABSTRACT

Pueblo, Colorado is undergoing a major transformation towards becoming a clean energy hub, with lessons for the whole country. The transition began as the community started to move away from its steel- and coal-based economy to found jobs and economic salvation in a diversified industry. We consider the evolution of the city's relationship with energy and manufacturing, and conclude with some lessons learned about partnership, government engagement, utility collaboration, and energy transition leadership.

1. Introduction

The path to enhancing clean energy production and usage can be very complex and diverse. The city of Pueblo located in the U.S. State of Colorado is dealing with its clean revolution. There, the transition from a coal-based energy matrix to a cleaner one is transforming the local economy, attracting investments and proving itself as a sustainable business model for other cities.

Pueblo is a mid-size American city shaped by a centenary steel industry. Despite that, its inhabitants faced a far-worse living standard than Colorado's more prosperous counties: in 2018, Pueblo faced an average 4.7% unemployment rate, which is much higher than the State average of 3% (Bureau of Labor Statistics, 2018) and almost 25% of its citizens lived below the US Federal poverty level (United States Census Bureau, 2019). Also, Pueblo's economy was heavily dependent on coal: Xcel Energy operates the Comanche power plant, a 1410 MW coal-fired powerplant in the city. Even though Pueblo is home to the Xcel Energy power plant, the city is served by the Black Hills Energy electricity utility, another of Colorado's major electric utilities. In the last decade, Black Hills imposed several rate hikes to the people of Pueblo (Jaffe, 2018), increasing the cost of energy over 60% over the last ten years (Pueblo Energy Future, 2019a). The increase in electricity cost represented an extra economic burden to a city where poverty is a reality faced by many. The electricity rate hike also impacted local business, where Black Hills itself lost 30% of Pueblo's industrial customers in 2016 (Jaffe, 2018).

Increasing electricity costs and low-income population observers could indicate a dark future for Pueblo to outside. However, the community looks to energy transition as a way to improve its economic condition. In 2016 (Pueblo Energy Future, 2019b), Xcel filled a plan to decommission two of the three Comanche coal power units based in Pueblo. The Xcel's Colorado Energy Plan forecast projects that Comanche 1 and 2 will be decommissioned in 2022 and 2025 respectively, ten years before the original plan. The 660 MW of capacity from these two power units are to be replaced by renewable generation facilities across the State of Colorado with over 2400 MW of capacity (Taylor, 2018). While not all this capacity will be installed in Pueblo, Xcel has signed a power purchase agreement (PPA) with Evraz, Pueblo's steel company, in addition to their 2400 MW of new renewable resources. The PPA guarantees the installation of 240 MW of solar energy at Evraz facilities.

Pueblo's plan focuses on eliminating coal and adding solar power to its energy matrix. However, the city is also taking benefit of the current expansion in wind power in Colorado. Thanks to Vestas, the largest wind tower factory in the world (Office of Economics Development and International Trade of Colorado, n.d.), Pueblo's economy benefits from other communities across the country that are investing in wind power resources.

By diversifying the economy to include solar and wind power, community leaders are re-shaping Pueblo's landscape and economy. This present paper details about the city of Pueblo's case. It focuses on how a poor city from Colorado is making use of a deliberate, well-planned energy transition to foster economic development. This case can serve as a benchmark to other policymakers. The paper heavily relies on grey literature. Pueblo's energy transition is happening now, and there are no published references in traditional scientific journals.

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2. Colorado energy plan as a driver to reduce electricity rate and CO_2 emissions

Pueblo faced a series of four successive electricity rate hikes, after Black Hills Energy purchasing Aquila in 2007, the city's former electric provider and constructed a new $487 million natural gas-fired power plant. Between 2008 and 2016 Pueblo's citizens saw their average electricity bill increases 58% (Worthington, 2016). Aquila had purchased its power from the largest Colorado utility, Xcel Energy, but Black Hills opted not to continue that contract. The state PUC-approved plan for Black Hills to construct an additional "peaker" turbine at the newly built Black Hills power plant was the last straw for many Puebloans. The utility's new turbine, which operates for only approximately 8 h per year during hot summer days, passed along $68 million in an additional cost to ratepayers.

Pueblo's Energy Future, a grassroots group, formed in response, leading multiple public protests and community forums that garnered nationwide media attention to Pueblo's plight. They highlighted the high number of customer disconnects that were occurring, due to residents not being able to afford their electric bills. Some estimates report that more than seven thousand homes were disconnected in Pueblo for lack of payment (Johnson, 2018; Sierra Club, 2017). Pueblo's Energy Future advocates packed the Pueblo Convention Center with angry residents when the Public Utilities Commission held a hearing in Pueblo in August 2016. Hundreds of residents testified to the Commission, and many described their frustrations that they were struggling economically, due to Black Hills Energy's decision to invest in a natural gas plant, when renewables were clearly emerging as the least expensive generation technology. As renewable prices continued to decline, community leaders recognized that a plan to adopt a renewables future was not only necessary but overwhelmingly popular amongst the community's residents.

Pueblo County's Economic Development & GIS office had created a plan that secured a viable path for utility-scale renewables to be constructed economically in Pueblo. They promoted the plan to Independent Power Producers, who construct renewable assets under contract with utilities, and found traction. The economics of the County's proposal showed that solar energy production in Pueblo could stabilize rates, operate at less expense than coal or natural gas generation and that IPPs could be profitable in building and operating large solar arrays. The County's Economic Development Plan noted that by focusing on renewables as a strategic industry cluster, Pueblo could curb both expenses of residents, and capitalize on a growing industry nationwide, bringing new jobs and revenues into the community's economy.

Pueblo's Energy Future advocates' ideology and the Sierra Club's "Ready for 100″ campaign, which promotes a 100% renewable energy generation goal for communities, aligned with the County's plan. The aligned goals became an energy transition plan for the community. Pueblo's energy transition plan creates a pathway to a cleaner and cheaper energy future. However, the Pueblo case is also part of a bigger picture: the Colorado Energy Plan envisioned by Xcel Energy.

Under this plan, Xcel Energy's generation matrix will change its main component from coal to renewables (Fig. 1). The plan was approved by the state PUC in August of 2018 and included:

- New wind capacity (1131 MW);
- New solar capacity (707 MW);
- New battery storage (275 MW);
- Early retirement of the Comanche 1 and 2 units with 660 MW of capacity;

Two key questions were considered under Xcel's Colorado Energy Plan (CEP) by the Pueblo community. First, residents wanted to clearly understand what the CEP effect on emissions and people's health would be. Second, residents wanted Xcel to explain how the plan would provide economic benefit to the community and Xcel's consumers statewide.

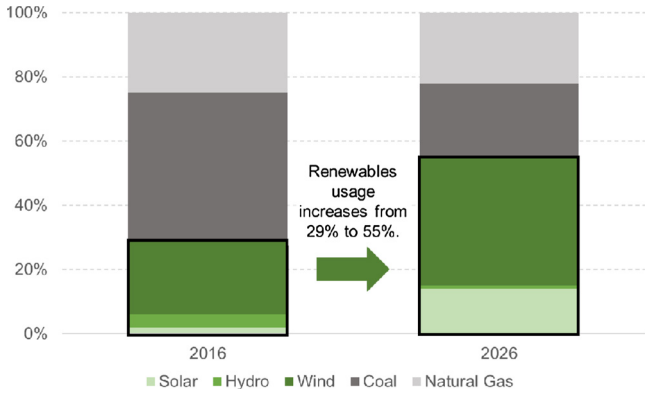

Fig. 1. Colorado's actual and estimated energy mix under Xcel's Energy Plan (Xcel Energy, 2017). Under the CEP, the renewables share in Colorado's energy matrix is expected to grow from 29% to 55%.

A Clean Air Task Force report states that the Comanche complex's, which includes all three Comanche units, CO_2 yearly emissions are around 9,653,188 tons (Clean Air Task Force, 2010). Also, the same report estimates that twelve lives are claimed every year related to health problems due to Comanche pollution. Pueblo ranks in second when it comes to deaths due to coal powerplant emission in Colorado (Table 1). So far as the data goes, CEP was deemed by intervenors testifying before the PUC, and by Pueblo's residents to be a reasonable path for Pueblo (Sierra Club, 2018).

However, what about the economic benefits? Despite the State average being low, residential consumers in Pueblo pays rates almost 42% greater than the State's average. The residential consumers pay the 5th most expensive electricity rate in Colorado (Fig. 2) Pueblo's industries also faced 70% more expensive rates than the State average. As an example, industries in the Denver area pay 50% lower rates (Local n.d.). This type of distortion creates incentives to companies flee from Pueblo, increasing, even more, its social problems. The utility anticipates that the rates will fall, despite the need for capital investment.

3. Wind and solar power acting as a reshaping force in Pueblo

Pueblo history is deeply rooted in the traditional American energy transformation industry. Historically, coal was the primary source of power for the local industry (DePillis, 2014). Manufacturing steel drove the local economy, where steel mills produced rail that expanded the transportation infrastructure of western United States.

Table 1
Colorado's coal-fired powerplants data (Clean Air Task Force, 2010). According to the Clean Air Task Force report, the Comanche Powerplant emissions causes twelve deaths every year related to fine particle air pollution. Also, the Comanche Powerplant is one of the highest source of CO2 emission among the other State powerplants.

Rank	City	Coal Powerplant	Deaths/year	Capacity	CO2 Emissions (1000 ton/year)
1	Moffat	Craig	18	1304 MW	9,109
2	**Pueblo**	**Comanche**	**12**	**1426 MW**	**9,653**
2	El Paso	Martin Drake and Ray D Nixon	12	462 MW	2,728
3	Routt	Hayden	10	446 MW	2,896
4	Denver	Cherokee	7	352 MW	2,397
5	Morgan	Pawnee	4	505 MW	3,402
6	Boulder	Valmont	3	184 MW	1,104
6	Larimer	Rawhide Energy Station	3	278 MW	2,315
7	Montrose	Nucla	1	100 MW	338

Fig. 2. Pueblo's electricity rates figure among the highest rate of Colorado: 5th for residential, 15th for commercial and 9th most expensive for industrial customers (Local n.d.). The number at the end of each bar represents the minimum and the maximum rate paid in Colorado in each rate segment.

The city's relationship with renewable energy began when Vestas Wind Towers America opened a wind tower factory in Pueblo in 2010. In Pueblo, Vestas found perfect conditions to build its facilities (Storrow, 2018): a skilled workforce, excellent transportation infrastructure, and a mix of financial incentives. Easy access to their consumer market was also highlighted, by Vestas' executive team as a primary driver to choose Pueblo for their factory location (Wineke, 2010).

Vestas' substantial increase in jobs in the renewable sector, was a factor in Pueblo's local government commitment to the energy transition as a path to economic growth. In 2017, the City of Pueblo approved the resolution n.13612 (City Council of Pueblo, 2019) committing themselves to reach a level of 100% of renewable energy source in the energy matrix. The resolution established, among other goals: energy efficiency, development of new business models and to guarantee that low-income citizens will receive economic benefits.

Pueblo's resolution is not a utopic desire for a clean future. It is in consonance with Xcel's CEP. According to Xcel, renewable energy generation will grow from 29% (2016 level) to 55% of their portfolio in 2026. Under the CEP, Xcel's plans will install 450 MW of solar capacity in Pueblo (Xcel Energy, 2018). An additional 240 MW of energy, separate from Xcel's CEP will be constructed, resulting from a PPA signed with Evraz for behind-the-meter solar energy supply. Pueblo County testified in favor of Xcel's CEP, noting the "…environmental and identity transformation it brings out the community." Pueblo County's Economic Development plans claim an elevated solar culture in the community will grow the number of skilled professionals and specialized companies in Pueblo. The increase in local solar expertise will provide the needed workforce and momentum to make the city's plans of reaching 100% renewable energy sources viable.

The Xcel PPA, independent from the CEP, is expected to induce several additional economic effects. First, it will reduce and stabilize Evraz's energy costs, help guarantee the continuity of the steel company's operations in Pueblo. Evraz approached the community's Economic Development leaders with a proposal to either expand their Pueblo steel operations or to leave Pueblo altogether. Expanding operations was conditional upon the community's ability to help Evraz reduce operational costs, which included their desire to reduce and stabilize their electricity costs. The community, Evraz, and Xcel found a path, where a solar energy PPA could allow this to occur, and served as an essential factor to maintain Evraz's operation there (Roper, 2017). For Pueblo, moving from coal to solar is a matter of economic survival. Due to the arrangement, the steel mill announced, during Evraz's 2018 Investor Day event, that is planning to invest $480 million in its Pueblo operation, and not to relocate (Evraz, 2018).

Second, there will be an increase in the demand for personal specialized in solar. Construction of the 240 MW PPA array and the Xcel CEP 450 MW arrays will be one of the most substantial developments of solar energy in the country (Roselund, 2018), and it is expected to create solar-related jobs. Lastly, it will reduce the total emissions related to the steel mill. One study predicts a 60% reduction in CO2 emissions (Erin and Farnsworth, 2018).

Also, the utility plan is expected to provoke a positive feedback kind of response in the city's business and lifestyle. Wind generation is expected to represent 40% of Colorado energy matrix by 2026, compared to the 2016 value of 23% (Fig. 1). Xcel's CEP plan indicates that they will develop over 1100 MW of additional wind capacity in Colorado (Xcel Energy, 2018). This increase suggests a growth in wind turbines which will augment Pueblo's economy, as Pueblo's Vestas plant will supply 100% of the wind towers.

4. Economic consequences of the energy transition for Pueblo

Pueblo saw itself on an economic trap. It has the fifth most expensive residential electricity rate in Colorado and faces an alarming statistics of 25% of its citizens below the poverty line (United States Census Bureau, n.d.). An industry in Pueblo can pay rates higher than it would pay in 84% of other Colorado's cities (Local, n.d.). However, the local electricity utility kept filling claims to raise rates (Worthington, 2016). Differently, from other towns in the State, Pueblo did not have a tradition in renewable energy. A good portion of its jobs and economic activity were related to the steel industry and the coal-fired power plants located in the city.

The high electricity rates were driving business out of the town (Jaffe, 2018) and started to affect the local steel industry, by far, one of the most important regional economic drivers. Due to high costs, Evraz was planning to go out of town (Roper, 2017). Pueblo faced the possibility of losing its steel industry, which would likely cause significant harm in the city's economy.

With local firms going out of business and the electricity rate hike, the situation for low-income citizens did not seem to have a bright future. Nonetheless, this was only a fraction of the big picture problems for local citizens. From 2001 to 2010, Pueblo's GDP per capita dropped 3.8% while, in the same period, the U.S. GDP per capita increased 8.1%. A two-digit unemployment rate was usual in the city until 2013. However, even today, the unemployment rate among Puebloans is higher than the State average (Bureau of Labor Statistics, 2018). Pueblo was facing what is called "generational poverty" (Markus, 2014), where a family remains poor for, at least, two generations (Payne, 2005). High electricity rate and low-income population created an environment where more and more families could not afford the bills and had their contract terminated with the local utility (Margolis, 2018; DePillis, 2014; Donahue and Farrel, 2018).

Between 2010 and 2018, Pueblo's experienced several essential events that created a basis for its energy an economic revolution. Vestas established the city as a major hub for wind energy because of its tower factory. By the same time, Vestas can make use of region's familiarity with the manufacturing process, EVRAZ steel mill is not only keeping is operation but also planning to expand it (Golightly, 2018) as the Xcel PPA guarantees low operational cost for the steel mill. Finally, the Colorado Energy Plan predicted the early decommissioning of Comanche 1 and 2, two coal-fired power plants. Despite the probable loss of eighty high-paying jobs after the decommission of these two units (Darrow, 2018), CEP is expected to create 133 in Pueblo County (Leeds School of Business Business Research Division, 2018). According to an economic impact study commissioned by Xcel, CEP would result in a net creation of 549 permanent jobs statewide from 2018 to 2040 (Leeds School of Business Business Research Division, 2018). The study pointed out that 1987 construction jobs statewide (516 in Pueblo) would be created in the first 5 years of the project. The study also documented a Gross Domestic Product gain of $203.6 million statewide ($44.0 million in Pueblo) would be realized in the first 5 years of the project.

However, electricity costs in the city were still high.

Local government began discussions to discover how renewable energy could help improve the local economy with jobs, but also with

lower electricity rates. In September/2017 Pueblo's city council voted a resolution (Pueblo Energy Future, 2018b) and started to search for ways (Pueblo Energy Future, 2018a) to end Black Hills utility agreement and, maybe, create its own municipal utility heavily based on renewable sources as part of the solution for the electricity rates.

While short-term solutions for the electricity rate hike may not be feasible, Pueblo envisions energy transition as the path to reduce power cost for local citizens. The cost reduction is based on competitive market solutions: with more specialized workers and companies related to renewables working in town, electricity rates are likely to go down in a mid-term horizon. Thus, the energy transition is related to local economic development through two main drivers. First, the increase in GDP based on more private investment and jobs creation for poverty reduction. Second, the lower electricity rate is expected to provide more equalitarian access to the grid, increasing citizens' life quality and dignity.

5. Conclusion and policy impact

This paper shows how the city of Pueblo is using energy transition to provoke local economic growth. The decommission of two primary Colorado coal-fired powerplant plays an essential role in this change. However, energy transition to Pueblo means more than reducing the use of high emissions fuels. It also intends to foster a business environment and job creation. Renewable energy stimulates the local economy with jobs creation in wind tower manufacturing, steel industry, and specialized solar labor.

The local government is acting to elevate Pueblo to a regional hub position for renewable energy. Also, the Pueblo community is assuming a position of leadership when it comes to integrating energy transition with community necessities. Despite still having one of the highest electricity rates in Colorado, local administration is engaged to provide a cleaner and cheaper future for local citizens making use of the cost-efficient market solution. Wind and solar power will play a fundamental role in local electricity rate reduction and fair access to the grid. Recently, Pueblo passed a resolution (City Council of Pueblo, 2019) committing the city to a 100% renewable energy matrix, but also, focusing on providing the low-income population with access to the economic benefits of the energy transition.

Pueblo's strategy to boost the local economy is heavily based on the Xcel's Colorado Energy Plan. The plan was received with enthusiasm by many Coloradoans, but it also has its critics. Some sources report that the CEP may not provoke electricity rate reduction and represents a profit-maximization strategy since Xcel is operated under a rate-of-return regulation(Naas, 2018; Richards, 2018; Gilchrist, 2018). Despite these criticisms, the Colorado Public Utilities Commission approved the plan (Xcel Energy, 2019). The city of Pueblo is also searching for alternatives for reducing the electricity rates as municipalizing the electricity utility to internalize the operations' revenue.

This case is a benchmark for policymakers. It shows how a community with deep economic dependence on coal and high electricity rates is re-shaping its future. Pueblo is taking advantage of the transition to an energy matrix strongly supported by cost-competitive renewables sources while keeping the traditional business running. In Pueblo, the energy transition is creating jobs and boosting the local economy.

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