Electricity in Broomfield:

A profile of the supply and demand of electrical power within the City and County of Broomfield.

Prepared By: Daryoosh Ardalan

Fall 2011

Introduction

As we approach the first quarter of the 21st century, we must take a moment to re-evaluate our role as planners. Major themes in planning have evolved from large scale, sporadic development to development that is resource efficient, dynamic, and serves a diverse mix of uses and people. Our new generation of planners will be tasked with recompiling our existing resources and creating new infrastructure that utilize our limited resources as efficiently as possible. One resource that we must continue to monitor, preserve, and actively include in our planning process is energy. The way that we produce and use energy is closely tied to the overall health and function of the Earth's climate and ecosystems. Another reason for our need to intensively consider energy in the planning process is the limited capacity of our existing energy resources. Our primary energy resource, fossil fuel, only exists in a certain quantity on Earth and its supply can only be re-produced on a time scale beyond our own. The finite pool of these resources exist beneath the Earth's surface, and extracting them is detrimental to the health of our planet. When we completely use these resources, our current infrastructure will become, essentially, useless.

The way that cities implement policy and build infrastructure greatly influences our use of these resources. Each city has its own character of energy consumption. This character is defined by a very broad range of economic, social, and political phenomenon. As planners, we have an opportunity to touch on all three of these components through public outreach, policy implementation and design. However, in order to better understand how we can influence the production and consumption of energy, it is important to take a closer look at individual geographies and look for common themes. For this reason it is important to analyze, and create an energy portfolio of cities at various scales. This particular study will focus on the City and County of Broomfield, Colorado. An analysis of this type is dependent upon the data that is available, as well as a general understanding of policy that effects the supply and demand of energy. The purpose of this analysis is to create a profile of the production and consumption of electrical energy in Broomfield. The profile will include an investigation of the supply and demand of electricity, policy that influences the economics of electricity, and a projection into the future of electricity in Broomfield County. In order to do this, it is important to understand the current characteristics of development and demographics in this county.

County Profile

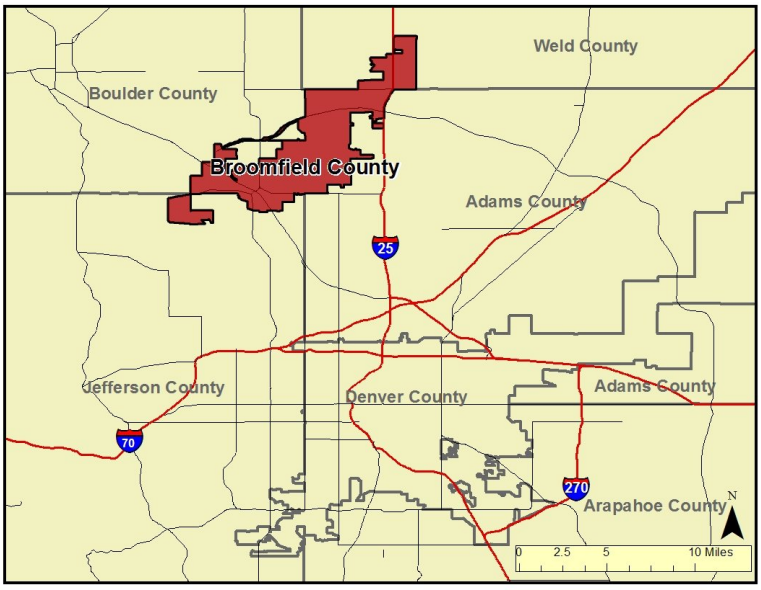

Figure I: Location of Broomfield; relative to the Denver Metro Area

The City and County of Broomfield is located approximately 15 miles north of Denver County on the Front Range of Colorado. In 2001, the municipality of Broomfield consolidated its jurisdication in Adams, Jefferson, Boulder, and Weld Counties to become Colorado's most recently established county. Broomfield County is also the smallest county geographically. As of April 2010, the population in Broomfield was determined by the 2010 United States Census to be 55,889 people. The population is relatively young population with about 75% of its residents under the age of 44. The population has been increasing rapidly through the past 40 years. Below, **Figure II** displays the population growth of Broomfield since the year 1970. Broomfield experienced a 770% population growth in 40 years. This is very significant, and may be the result of the construction of the Boulder – Denver Turnpike. The highway dropped its toll requirement in the 1970's and this spurred a great deal of development between Denver and Boulder.

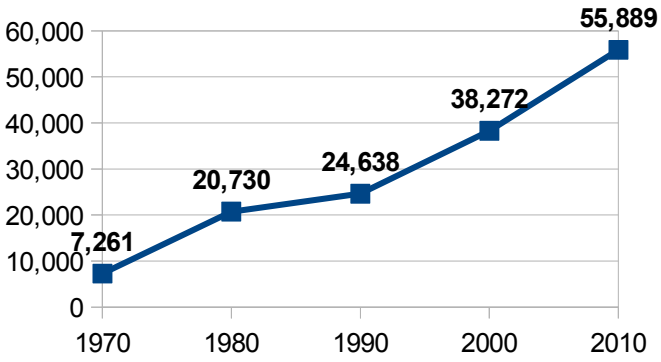

Figure II: City of Broomfield Population Growth

The city was primarily agricultural in nature and was named after its broomcorn fields. The city shifted from an agricultural center to a residential community, following the development of several large business centers in Boulder and along the Boulder – Denver Turnpike corridor. More recently, Broomfield has experience a huge commercial business development in its southern portion along Highway 36. **Figure III** displays the development pattern of the city of Broomfield.

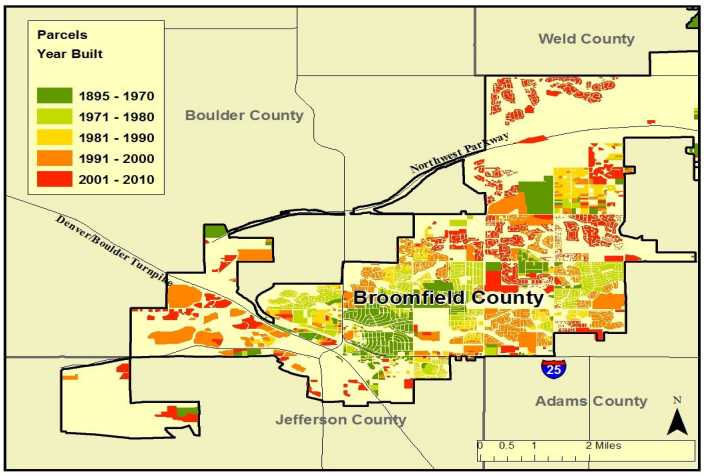

Figure III: Development pattern of Broomfield

Broomfield has a primarily residential character. Recent developments have been in the southwestern and northern portions of the county. The developments to the north are primarily large single family homes while the southeaster portion contains almost entirely commercial business developments. The opening of Flatirons Crossing Mall in the year 2000 spurred a huge development of office space in the area known as Interlocken. This massive commercial business development is located along the Highway 36 corridor and is responsible for the majority of Broomfield's electricity consumption. Flatirons Crossing contains approximately 1.6 million square feet of commercial building space. The surround Interlocken office area has a great deal more developed building space, however data is not available to estimate the square footage of these buildings. **Figure IV** displays the land use pattern in Broomfield County.

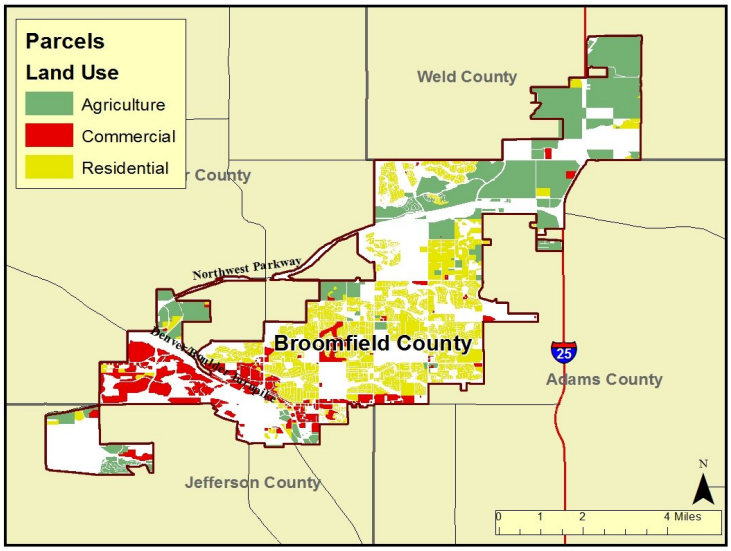

Figure IV: Land use in Broomfield County

The large commercial uses in the southwest portion of the map indicate the Flatirons Crossing Mall and Interlocken Developments. There is very little industrial land use in the county, and a large portion of northern section of the county in being preserved by and urban growth boundary. The city of Broomfield currently protects about 5,000 acres of open space, with another 2,500 acres of parks and recreation areas. Despite the urban growth boundary, the majority of new residential development is occurring in the northern portion of the county.

The housing character of Broomfield County is similar to that of Denver, with just a few differences. Broomfield has a fewer percentage of multi-unit housing and a higher average number of people per household. **Figure 5** displays a comparison between the percentage of multi-unit housing and average people per household in Broomfield and Denver counties. This indicates that Broomfield is less dense than Denver, overall. The lower density makes sense because Broomfield is primarily suburban in nature, and development has followed the standard subdivision plat design. This lack of density usually leads to an inefficient use of energy resources.

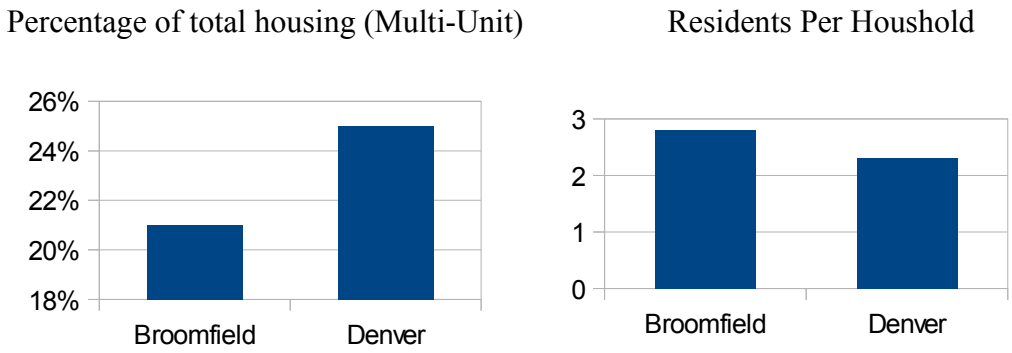

Figure V: Housing profile comparison

Another indication of the low-density nature of residential development in Broomfield is the fact that approximately 84% of its housing units are single family detached housholds. Of the 22,646 housing units in Broomfield in the year 2010, 18,863 were detached households. This understanding of the residential and commercial sprawl that exists in Broomfield will help understand the dynamic relationship between the supply and demand of electricity consumption in Broomfield County. Knowing that large scale commercial development exists will allow us to focus our efforts and determine if these low density commercial and residential areas significantly contribute to the demand for electricity consumption in this county.

Current Supply of Electricity

The City and County of Broomfield primarily receives it supply of electrical power from Xcel Energy. Recent developments and some residential areas in the northern and eastern portions of Broomfield County purchases electricity from United Power. These two companies are similar in that they rely primarily on coal for the generation of electrical energy. They do, however, have some differences in their energy source portfolio, as well as their business structure. United Power is a non-profit energy cooperative, which means that it is owned by the customers which it serves. The public elects a board of directors to manage and operate the cooperative. This allows residents of the community to have some control over their electricity purchases. United Power purchases its power from Tri-State Generation and Transmission. Tri-State generates and provides electricity for 44 cooperatives in the Rocky Mountain region. Its generation portfolio is not very much different from Xcel's but Tri-State does provide good support for small scale and local electricity generation projects. Figure VI displays the location of Tri-State's major generation facilities in Colorado.

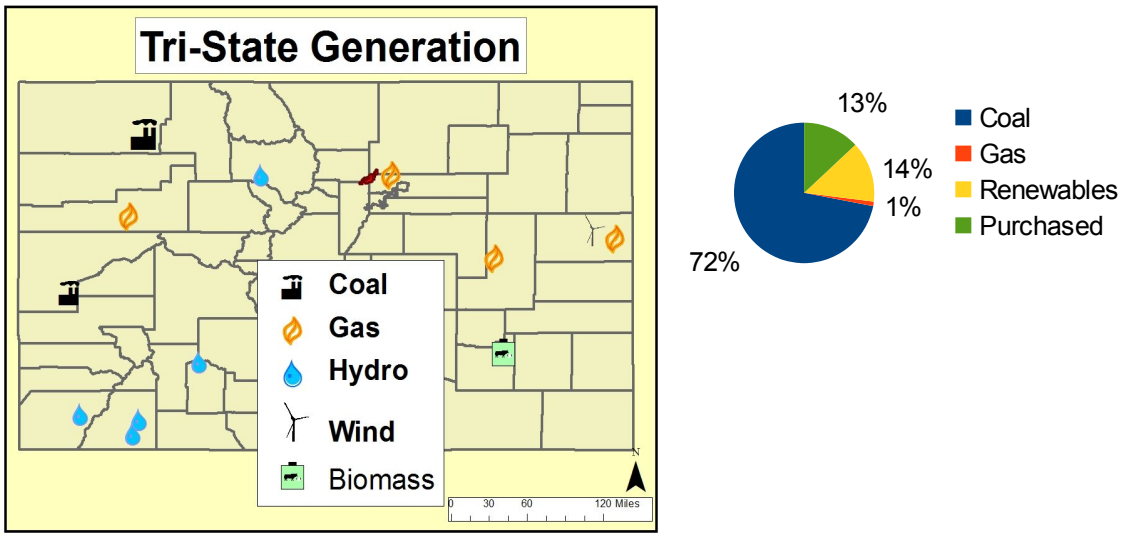

Figure VI: Tri-State generation locations and profile

Tri-State does not consume very much natural gas, given its abundance on the front range. The company prefers to explore local solutions and smaller scale renewable resources. It also supports large scale wind and solar projects by purchasing a portion of its electricity from outside of its region.

Xcel Energy is a corporation that operates to make a profit. This becomes evident in its decision to utilize the abundant natural gas resources present on the front range. It is the largest provider of electrical power in Colorado, and is responsible for generating its own power. Xcel does have some investment in renewable energy projects; including three wind farms which produce up to 327MW of power. The nature of Xcel's production largely follows the traditional structure of a few very large scale power plants producing electricity for a very large number of people. This results in greater ecological damage at individual generation sites, increased loss of energy during transmission, and utilization of resources that produce a high number of harmful emissions. **Figure VII** displays the location and profile of electricity generating facilities that are operated by Xcel Energy.

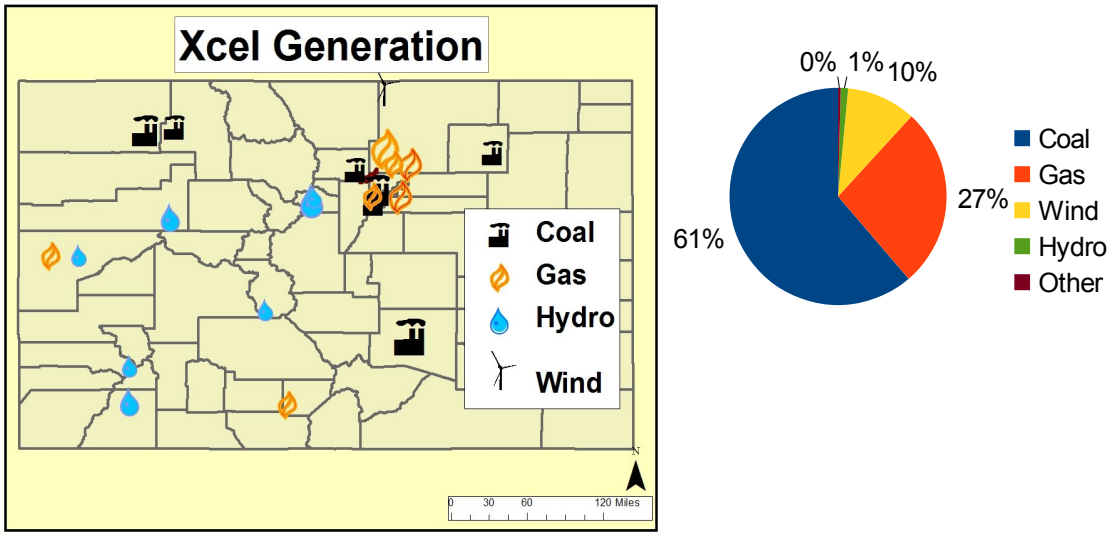

Figure VII: Xcel Generation locations and profile

Natural gas is used to generate over a quarter of Xcel's supply of electricity. It would seem that this large company's decision to utilize natural gas resources is largely an economic decision. A company that operates for profit tends to seek the solution which benefits the income of the company while minimizing production costs. This kind of business operation does not always lead to the most sustainable solution, or that which provides the greatest benefit to the customer. The portion of Broomfield that is served by the United Power cooperative is displayed in **Figure VIII** below. It should be noted that all areas outside of United Power's service area are served by Xcel Energy.

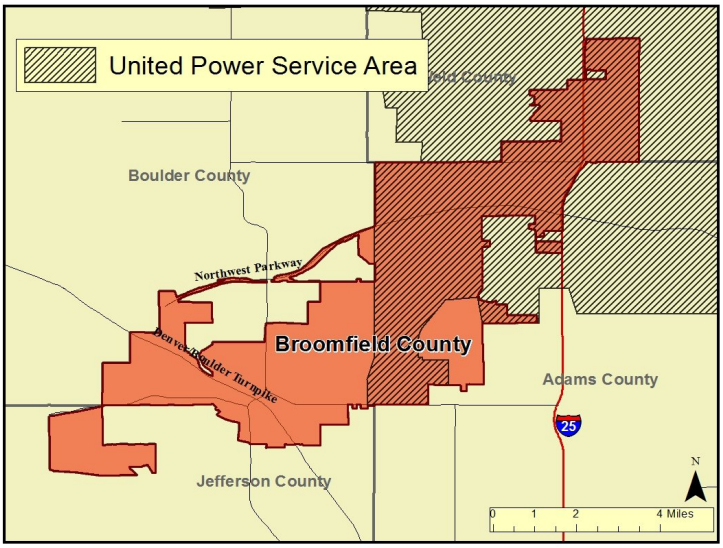

Figure VIII: United Power service area

Current Demand and Emissions

The suburban sprawl and large scale commercial development that has occurred in the past 20 years has caused Broomfield to consume electricity at a rate that exceeds expectations. An in-depth analysis of energy consumption in Broomfield that was conducted by University of Colorado Denver graduate students revealed the extent and nature of consumption in Broomfield County. It was estimated that the electricity demand for Broomfield was approximately 2.13 Trillion BTU in the year 2007. This is comparable to an estimated consumption of 0.9 Trillion BTU by the City of Boulder in the year 2006. The City of Boulder has a population of approximately 95,000 people. This is nearly double the population of Broomfield, yet Boulder's demand for electricity is less than half of Broomfield's.

It seems that this unreasonable consumption is driven by the regional commercial centers located at Flatirons Mall and Interlocken. The UCD profile of Broomfield estimate that Broomfield's average commercial building consumption is more than twice the national average. **Figure IX** compares Broomfield's electricity consumption by commercial buildings in the year 2007. It is much greater than the region and the nation.

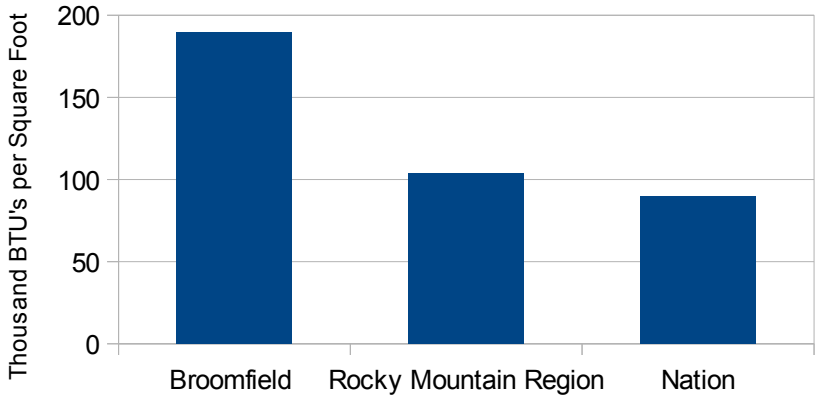

Figure IX: Commercial building electricity consumption

This unequal distribution may be partly because Broomfield provides regional commercial services, and that people from other counties often travel into Flatirons Mall and Interlock to work and shop. This forces some of the energy burden onto the City and County of Broomfield. It is interesting to point out here the regional dynamics of energy. It would seems that Boulder is far more advanced than Broomfield when it comes to energy conservation, however residents from Boulder likely utilize the employment and retail services provided by Broomfield County. This allows Boulder to display an advanced understanding of energy conservation while simply distributing the energy consumption to its neighbors in Broomfield County.

Still, commercial buildings in Broomfield are consuming very high amounts of electricity. Our current pattern of consuming electricity leads directly to the destruction of ecological systems and natural resources. The release of greenhouse gases and other pollutants are detrimental to the composition of our atmosphere. It was estimated by the UCD report that electricity use in Broomfield County was responsible for the emission of approximately 475,000 metric tons of Carbon Dioxide. Emissions resulting from electricity in commercial buildings was responsible for approximately 63% of that total number. To further understand this inequality, we must look at the number of commercial parcels compared with residential. Broomfield county contains about 17,500 residential parcels and just about 720 commercial parcels. The commercial buildings are much larger than residential, but that means that effective implementation of efficiency measures is extra important. When looking at the evidence, it would seems that controlling the use of electricity in commercial buildings is crucial to lowering Broomfield Counties demand for electricity as well as the resulting emissions of greenhouse gases. In order to understand how the city may be able to control this use, it is important to understand the existing policies that influence the design, development, and maintenance of these commercial buildings.

Broomfield Sustainable Policy

In the year 2005, the City and County of Broomfield released a comprehensive planning document which contained an environmental stewardship section. The plan contained a vision statement which encouraged sustainable living and working in Broomfield. In 2008, a large panel of educators and civil employees revisited the environmental section of the comprehensive plan and revised it to create the recently adopted 2011 City and County of Broomfield Sustainability Plan. The

plan was the product of collaboration between the University of Colorado Denver, National Civic League, and the City and County of Broomfield. In January of 2011, City Council adopted the plan as an amendment to the 2005 Comprehensive Plan. The document is available for reference in policy decision making processes. Since it is a new document, its effects have not been able to extend through the county's infrastructure and development fabric. Nonetheless, it is important to observe how and to what extent this plan will address the commercial use of electricity in Broomfield.

The 2011 Sustainability Plan goals are inspired by a vision statement that and supported by a series of policies. The energy-related section of the plan has three goals containing several policies. The goals and policies are as follows:

Goal B-I) Conservation and Energy Efficiency

Policy B1: Utilize incentives to encourage awareness and energy conservation efforts of Broomfield citizens and businesses, promote a reduction in consumption and use innovative technological solution with all energy providers to achieve such reductions through community participation and programs.

Policy B2: Establish and use standards, policies and practices for new development and redevelopment that encourage and support conservation, use of alternative energy resources, water conservation and pollution prevention/reduction.

Goal B-II) Development of Alternative Energy Technology

Policy B3: The City and County of Broomfield will lead by example and serve as a role model by utilizing new and emergin technologies.

Policy B4: Continue to monitor environmental regulations to assure compliance with all relevant federal, regional and local environmental laws, standards, policies and goals.

Goal B-III) Provision of Electrical Services

-This goal does not include policies, however it suggests that Broomfield "consider the establishment of a municipally owned and operated electric utility service at the time of contract renewal."

The first goal begins to confront the drastic commercial consumption of electricity, but it mainly addresses new developments. It does not contain specify policy for the conversion of existing buildings to more energy efficient designs. The second policy encourages the development of renewable and alternative energy technologies; which can include smart grid monitoring and distributed energy generating technology. The development of renewable energy generation in Broomfield will be interesting to monitor in the future, given Colorado's abundant pool of solar and wind resources.

Finally, the plan considers the long term possibility of discontinuing its contract with Xcel and operating its own municipal power company. It is difficult to find disclosure of when the contract will expire, neither Broomfield nor Xcel Energy have that information readily available. This option would require considerable planning to achieve, given that municipalization of electricity is a rather new concept and has yet to be tested by a wide enough range of cities. Even if the municipalization of Boulder's electricity supply is successful, it has been demonstrated that Boulder's existing infrastructure is more energy efficient and that extensive demand-side management has already been initiated in Boulder. The conversion of Boulder's electricity supply is risky, but it should be considerably easier than a similar undertaking in Broomfield.

Future Scenarios in Broomfield

Given historic trends in population growth and commercial development in Broomfield, it would be reasonable to predict a continuing drastic increase in population accompanied by large scale commercial development. However, when considering the condition of the global economy, geographic size and established urban growth boundaries, it does not seem that growth will continue at its current pace. Instead of making projections into the future based this current rapid growth in population, this report will create scenarios based on policy decisions to be made by officials in the City and County of Broomfield. The scenarios will range from existing policies without strong implementation of the sustainability plan to an intense focus on energy where Broomfield focuses on demand-side management, distributed energy generation and municipalization of their electricity supply.

Scenario I: Business as usual, ignore the sustainability plan.

Although Broomfield adopted the sustainability plan as an amendment to its 2005 comprehensive plan, it is not required to implement any of the policy defined by the document. The plan is available as reference and both residential and commercial developers still have a choice to ignore the actions suggested by the plan. In this scenario, businesses within Flatirons Mall and Interlocken will not make any effort to convert to low energy designs and new developments will continue to occur in the same large scale, inefficient manner as they have during the past 20 years. This will force Broomfield to continue to bear the burden of providing electricity to people who migrate into Broomfield County for employment or shopping opportunities. The cost of this type of consumption will be very high and future businesses in Broomfield may have difficulty competing with neighboring businesses which chose energy efficient solutions with a decreased reliance on fossil fuels.

Scenario II: Follow the Sustainability Plan

Given this scenario, Broomfield will embrace the Sustainability Plan it adopted in 2011. All city and county buildings will be converted to meet Energy Star requirements and its residents will be well informed of the economic and environmental benefits of conserving energy. Sustainable behavior will be popular among Broomfield residents, and this will be impressed on visitors to the area. The vast majority of new commercial developments will incorporate energy efficient technology and about half of the existing businesses will have converted to energy efficient designs. Broomfield will continue to fill its role as an employment and commercial shopping center, however it will do so with less environmental impact and may even become an example of energy efficiency.

The generation of electrical energy will also be embraced by residents of the county. Residents will boast of the amount of kilowatt hours they produced with their small scale solar and wind projects and will reap the economic benefits of retrofitting their homes with energy efficient technology. The consumption of energy will continue to increase, but as large scale commercial developments utilize energy efficient designs and developers run out of room to continue developing, there may be some stabilization of electricity consumption. After development slows and designs are augmented, Broomfield's consumption profile may begin to reflect the city of Boulder's. This will allow Broomfield to remain regionally competitive and gain some notoriety in the sustainable civic community.

Scenario III: Take the big risk and municipalize electricity

In the odd chance that Broomfield decides to completely take on the challenge of becoming its own supplier of electricity, it will be assume great risks. These risks come with great reward, if the process is completed very carefully with a certain degree of economic luck. The front range in Colorado has a significant amount of renewable resources, and even more can be found in the eastern plains. It is possible for Broomfield to successfully integrate its electricity infrastructure into its surroundings and cooperate with counties to the east to harvest and transmit enough energy to supply its intense demand. It is very likely that Broomfield will continue to purchase a significant amount of power from providers such as United Power, but will be burdened with the task of administering the power to its residents and business owners.

It seems that Broomfield is not currently ready for the responsibility of administering its electricity supply. Scenario III involves a great amount of risk and is likely to be politically controversial topic. The stability of Broomfield's energy supply will face many challenges and the administration of this resource will consume a large amount of public resources. It seems that, given the existing nature of electricity consumption in Broomfield county, the government is not ready to assume the role of electricity provider for the entire county. Given the existing dynamics of electricity production and consumption in Broomfield, it seems that this scenario is not realistically viable for the future of the city.

Policy Recommendations

Given the current consumption pattern of commercial buildings in Broomfield as well as the risks involved in municipalizing the supply of energy in the county, the most beneficial policy track for Broomfield to follow would be similar to that which is adopted by Scenario II. It seems that the most beneficial as well as feasible option for the City and County of Broomfield pursue in relation to electricity consumption and production would involve intensive policy incentives for commercial

developments to embrace energy efficient designs. Energy production within Broomfield would have occur on a small scale, given its small geographic nature. The majority of efforts will have to be placed on demand-side management of the city's electricity. Utilizing incentive programs, such as those provided by Energy Star, will allow residents and business owners to simultaneously save money and energy resources.

Beginning with a strong push to take energy efficiency measures in public facilities, the City and County of Broomfield have the opportunity to influence its residents and visitors to utilize existing energy resources more efficiently. Re-designing existing public facilities and developing new public buildings to meet Energy Star standards will demonstrate the steps and results of conserving energy at a small, local scale. If energy savings are presented to the public in a manner which also displays the long-term economic benefits of conserving energy, then the movement has potential to become popular and Broomfield residents will make the shift to energy efficient lifestyles. Combining this effort with an effort to provide tax incentives for conservation as well as subsidies for small scale generation can produce a positive, energy-aware response from people in Broomfield County.

Many tax-based or other incentives are offered by the United States Department of Energy. Some examples of incentives provided for energy efficiency include; a $1.80/ square foot tax deduction for buildings that meet ASHRAE standards as well as benefits offered by the Energy Policy Act of 2005. It is up to Broomfield to utilize the language set forth in its sustainability plan and find a diverse and creative set of solutions to reduce its disproportional dependency on electricity.

In addition to the demand-side management techniques described above, it will be important for all municipalities, including Broomfield, to increase its utilization of Colorado's abundant natural resources. **Figure X** and **Figure XI** display the wind and solar resources in the state of Colorado. It is obvious that both resources exist plentifully in Colorado, and with efforts to increase transmission connectivity, a distributed matrix of electricity production can be created.

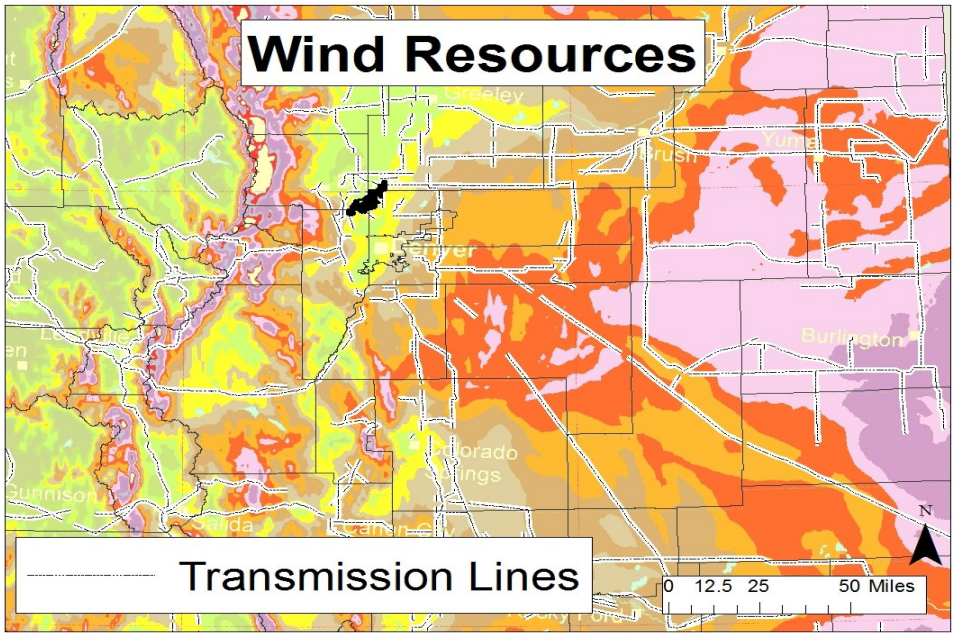

Figure X: Wind resources in Colorado

Figure X indicates a great amount of wind resources existing in the eastern great plains portion of Colorado. If Broomfield is able to collaborate with counties that contain this resource, then it may be able to connect its transmission lines to remote generation facilities and create a dynamic electricity portfolio that is composed of primarily renewable resources.

Figure XI displays the solar potential for the state of Colorado. The orange color that spreads across the entire state indicates that all of Colorado receives enough sunlight to generate electricity. This means that distributed electricity generation can utilize this solar resource on many scales and the economic viability of solar projects will depend on sources of funding and strategic placement of solar equipment.

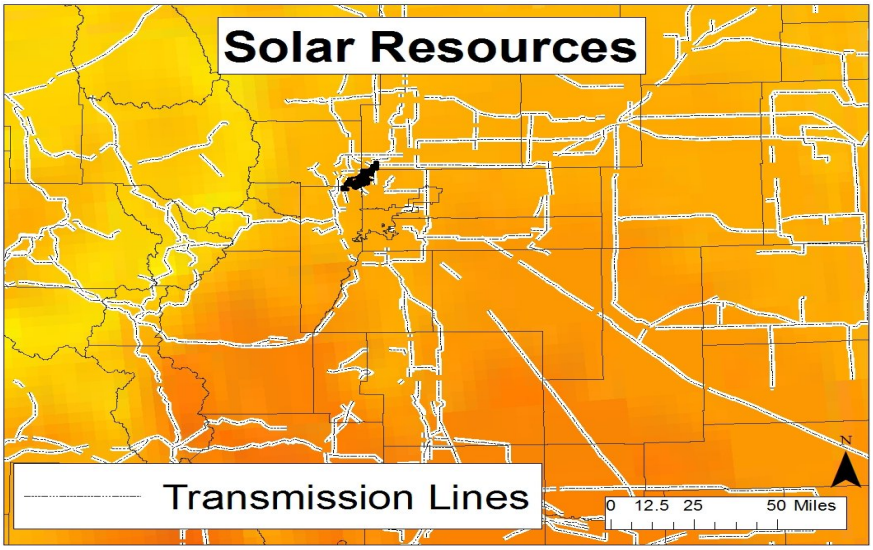

Figure XI: Solar resources in Colorado

Conclusion

It seems that Broomfield has recently taken great steps towards maximizing energy efficiency and minimizing harmful emissions related to the consumption of electricity. However, it will take time for these changes to materialize in the infrastructure and developments within the county. The future of Broomfield's energy profile is dependent upon officials within the city's government to enforce the sustainability plan and encourage residents and business owners to reduce electricity consumption through both regulation and incentives. Planners in Broomfield County have the task of evaluate the energy related implications of every decision that is made by the city. Planners have to opportunity to design, create policy for, and frame the discussion of energy use in Broomfield County. It will be important to be aware of the energy implications of all policy decisions that reveal themselves during he civil decision making process.

As it is now, Broomfield appears to be a bit of an energy hog in the region, but it is important to recognize the fact that Broomfield also provides many of the employment and commercial services in the region. Despite its small size, Broomfield contains a great amount of in-migration which results in large amounts of sales tax revenue. This will allow Broomfield to be more creative when designing infrastructure and government buildings to set and example for the rest of the population. Broomfield can use its resources to become an example in the region of how one type of large scale development pattern can convert itself through economic incentives, to become a leader in energy efficient development. The sustainability plan was certainly the first step to realizing this ambition, and as the public follows the government's example, Broomfield may experience a transformation from one of the least efficient counties to one of the most respected, highly developed counties in the Front Range of Colorado.

Resources

Energy Information Administration- State Energy Data System (SEDS)
http://www.eia.gov/state/seds/

City of Arvada Sustainable Energy Inv. and Action Matrix 2006
http://static.arvada.org/docs/1259965053Inventory_and_Action_Matrix.pdf

City of Boulder Office of Environmental Affairs (2007) Renewable Energy Strategy
http://www.bouldercolorado.gov/files/City%20Council/Study%20Sessions/2008/04-08-08/attachment_d.pdf

City and County of Broomfield GHG Inventory Final Report 2008
http://www.broomfield.org/environment/Broomfield_GHG_Inventory_Report_Final.pdf

City and County of Broomfield GIS Data
http://www.broomfield.org/GIS/

City and County of Broomfield Sustainability Plan
http://www.broomfield.org/environment/Sustainability_Plan_011411.pdf

City and County of Denver Climate Action Plan
http://www.greenprintdenver.org/docs/DenverClimateActionPlan.pdf

National Renewable Energy Laboratory Renewable Energy Maps
http://www.nrel.gov/renewable_resources/

Tri-State Generation and Transmission
http://www.tristategt.org/

United Power
http://www.unitedpower.com/home.aspx

US Census
http://www.census.gov/

US Department of Energy Bulding Technologies Program
http://www1.eere.energy.gov/buildings/tax_commercial.html

USGS GIS Data
http://cumulus.cr.usgs.gov/

Xcel Energy
http://www.xcelenergy.com/