CITY OF BOULDER MUNICIPALIZATION EXPLORATION PROJECT:

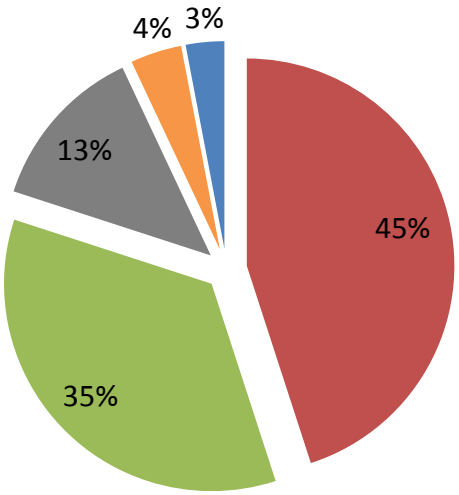
Purchasing Power

To determine the feasibility of creating a local electric utility, the city modeled several different resource mixes, or "portfolios," that the utility could purchase at different costs. These portfolios were meant as examples, as the exact mix of resources would be developed through a full resource planning process of the type conducted by utilities. The modeling performed to date assumes that the city would contract with developers through power purchase agreements (PPAs) that would meet most of Boulder's power supply and reliability needs. This means that the modeling focused on large contracts for wind energy, balanced with natural gas where necessary for reliability.

In some of the options modeled, the utility was allowed to purchase some amount of energy from the wholesale market, outside of PPAs. Market purchases would likely include coal power proportionate to what Xcel Energy currently has (between 50-60%). For the July 2013 modeling, all of the options invested $3.5-$7 million annually in local solar power. Subsequent modeling would look at how the utility could increasingly focus on local energy.

The chart below shows the portfolio for the "Low Cost" option in 2017 (considered "day 1" in the modeling)—it includes nearly double the renewable energy Xcel has forecast that it will have on its system at that time (23%). This is the option with the lowest amount of renewable energy modeled for Boulder.

- **Natural Gas**, a fossil fuel used to fill in, or "firm," intermittent resources such as wind.
- **Wind**, which is treated as "baseload" renewable energy.
- **Coal**, while not included in a Boulder portfolio specifically, could come from a wholesale market purchase, including a purchase from Xcel. The utility could also choose to exclude coal entirely.
- **Solar**, based on an incentive program that invests $3.5 million annually in local photovoltaics.
- **Hydroelectricity**, supplied by the city's own hydroelectric generators.



The modeling was conducted using a software program called HOMER, which looks at Boulder's energy and capacity needs on an hourly basis over 20 years. Details on the many cost assumptions that were used in HOMER were presented as part of the February 26, 2013 memo, attachment D. Some of the numbers have been updated since February. This summary focuses on the updated numbers.

Natural Gas Purchases	Natural gas prices have historically fluctuated as a result of a number of factors. That volatility can be managed in several ways: for example, short-lived price spikes can be managed by offsetting higher costs with the utility's cash reserves. To understand the impact of long-term price changes, the modeling includes three price trajectories based on what Xcel Energy forecasts as part of its most recent Electric Resource Plan (ERP). Xcel Energy updated its price forecasts in April 2013. The city's model was updated to reflect those changes by reducing the "low" and "median" price but increasing the "high" price. This had the impact of increasing the overall range of costs. The gas prices, shown below, include transportation costs and are designed to cover about 80% of the reasonable prices the utility could see over 20 years.

Natural Gas Purchases (continued)

NATURAL GAS PRICES IN $/MMBTU (2011 dollars)					
	2017	2022	2027	2032	2037
High Price	$7.97	$9.80	$10.77	$11.02	$11.21
Median Price	$4.04	$4.96	$5.45	$5.58	$5.66
Low Price	$2.06	$2.53	$2.77	$2.83	$2.88

Natural gas is often referred to as a bridge fuel to manage large amounts of intermittent renewable energy such as wind or solar. The modeling optimizes between PPAs with different characteristics (such as generator type and heat rate). Fifteen percent more natural gas capacity is purchased than is needed in accordance with industry standards related to reliability. Because of growing concerns related to hydraulic fracturing, staff is looking into best management practices related to natural gas extraction and whether that can be included in contracts.

Wind Power Purchases

Given that wind power is the cheapest renewable energy option, the modeling assumes the utility would enter into a number of wind contracts to meet Boulder's electricity needs. Wind would be a "first-choice" resource, with natural gas purchases to manage intermittency. The wind contracts are treated as "must take," meaning that even if Boulder doesn't need the wind electricity at the time it is generated, it still pays for it. In a resource planning process, the utility might look for contracts that include provisions about buying back or curtailing excess electricity to reduce expenses. Because Boulder would want a diverse portfolio of resources, the utility likely would contract with a number of geographically diverse wind projects, with varying contract terms and lengths.

Wind prices were modeled at $31 (low), $50 (median), and $68 (high) per MWh with minor variations over 20 years. The high price includes costs for integration and coal cycling—fees charged to manage wind's variability with coal and gas—and all prices include costs for transmitting wind power. The prices (up from a $38/MWh median in February) reflect a consensus by community working group members that wind prices may be higher in 2017 than today because the federal Production Tax Credit (PTC) may not continue in its current form. However, the median price also assumes that technological improvements will reduce wind power costs.

Coal and the Wholesale Market

A local utility portfolio might have some amount of power attributable to coal generation if it were to purchase power from the wholesale market or directly from Xcel Energy. Whether coal would be part of the utility's resource mix would be a matter of market conditions and policy considerations. Except for the "No Coal" option, the modeling generally allows the utility to make some amount of market purchases when they are cost-effective. The wholesale market resource mix was assumed to be that of Xcel's resource mix because it acts as a balancing authority in the region.

The coal prices that went into the modeling came from Xcel Energy's 2011 Electric Resource Plan. In 2011, Xcel reported that coal prices were $1.75/MMBTU; in an April 2013 update, it reported coal prices for 2011 were $1.84/MMBTU and $1.98/MMBTU in 2012. This update impacts Xcel's costs over 20 years in the modeling as well.

Solar Power

Boulder currently has more than 12 MW of local solar photovoltaics (PV). The modeling assumes that solar installations would continue at a moderate pace, resulting in about 20 MW of installed capacity in 2017. For the July modeling, the median levelized cost of electricity from solar PV was $0.13/kWh for the expected mix of residential and commercial installations. This price excludes the current Investment Tax Credit (ITC) but includes favorable financing through a municipal utility loan program. Each resource mix modeled allocated at least $3.5 million per year in the form of rebates and incentives. This is a slightly more than what Xcel is believed to have spent in Boulder on Solar*Rewards in 2012. Additionally, a "Local Generation" option was added that doubled annual investment to $7 million.

Hydroelectricity

Hydroelectric capacity was held constant at 10 MW for purposes of modeling, despite the possibility that the city's 8 hydroelectric generators could be modified in the future to generate additional electricity.

Carbon Prices

It is unclear whether there will be federal or state legislation related to carbon emissions. That said, virtually all utilities model some level of carbon risk in the future. The city's modeling includes 3 carbon prices, which were based on the Synapse Energy Economics' *2012 Carbon Dioxide Price Forecast*. Synapse analyzed Energy Information Administration data and existing utility resource planning efforts to develop three price trajectories depending on whether congressional action is limited (such as efficiency standards) or more aggressive (such as a cap-and-trade program).

CARBON PRICES IN $/METRIC TON (2011 dollars)					
	2017	2022	2027	2032	2037
High Price	$10.58	$19.55	$28.52	$37.49	$46.47
Median Price	$5.88	$10.86	$15.85	$20.83	$25.82
Low Price	$1.18	$2.17	$3.17	$4.17	$5.16

In addition to the three carbon prices, the models were designed to test prices at $0/ton (no carbon price) and $20/ton, which reflects what the Colorado Public Utilities Commission has approved for Xcel Energy's Electric Resource Plan.

Frequently Asked Questions

During the city's modeling process, City Council and the community raised a number of key questions. While not exhaustive, the following tend to be the most frequently asked. Attachment A of the April 16, 2013 City Council packet includes a number of questions and answers related to the modeling effort.

1. **Have you conducted a full life-cycle analysis (LCA) on carbon emissions?** No, not at this time. However, members of the community have voiced concerns that poor management of natural gas extraction may lead to larger-than-modeled amounts of GHG emissions. The need for LCA will be evaluated moving forward, and the city will be looking for alternatives to hydraulic fracturing of natural gas. Best practices for gas extraction operations could be incorporated into resource selection processes.

2. **What is the impact of the Production Tax Credit (PTC)?** The PTC is a $23/MWh tax credit available to wind resources. It contributes significantly to wind industry jobs and encourages the use of renewable energy. The PTC has been extended to wind projects that have begun construction before the end of 2013. Although the PTC has traditionally been extended, its future is currently uncertain.

3. **Have you looked at transmission access to wind farms?** Yes, although staff did not conduct any load flow or congestion studies. Xcel recently received bids for 6,500 MW of wind capacity in Colorado and Wyoming as part of its 2011 Electric Resource Plan. All bids were required to assess transmission availability and Xcel's transmission study estimated over 1,000 MW of capability available on its system.

4. **How is wind curtailment being handled?** The modeling assumes that there is always enough energy being purchased to meet utility customers' needs. However, because the wind contracts are created as "must-take," this means the utility is sometimes purchasing more wind power than customers are using. To be conservative, the financial model assumes all of that wind is being purchased even if it is not being used (i.e. the wind energy is "curtailed"). It is likely that some of that electricity could be resold on the market, which could add millions of dollars in revenue to the utility each year—this potentiality has not been incorporated in the model.

5. **What are "coal cycling" and "integration" costs?** Integration costs are costs that Xcel attributes to wind power because it is intermittent. Integration refers to the "hidden" costs of regulation, system operations, and gas storage. Coal cycling is a particular type of integration cost that is assigned because Xcel has invested heavily in coal plants, and most coal plants cannot rapidly change their power output. It refers to changes Xcel would have to make to operating its coal baseload plants when there are very large amount of wind. Integration costs are increasingly manageable through better wind forecasting and more flexible generation assets.

Frequently Asked Questions (continued)	6. **Could the local electric utility still be cost-effective if a carbon tax isn't passed?** Yes. Removing the carbon price does have an impact on the likelihood of the local electric utility being able to provide as much cost savings compared to Xcel over the long term, because Xcel's costs would not be as high. However, at $150 million in stranded and acquisition costs, and with a Low Cost resource mix, it is still more likely than not that the local electric utility could produce cost savings over time.

Additional Resources	Modeling results are available in the July 23, 2013 Study Session memo. • Xcel Energy, Modeling Assumptions Update (Apr. 16, 2013), 2011 ERP (Docket 11A-869E) (link) • City staff analysis, Att. A to Apr. 16, 2013 memorandum, on coal fuel costs (link) • LBNL, 2011 Wind Technologies Market Report (link) • NREL, TMY wind hourly profile for Spring Canyon in Peetz, CO • NREL, TMY solar hourly profile for Broomfield area (link) • Xcel Energy, 20-Day All-Source Report, 2011 ERP (Docket 11A-869E) (link) • Xcel Energy, 20-Day PTC Wind Report, 2011 ERP (Docket 11A-869E) (link) • Synapse Energy Economics, Inc., 2012 Carbon Dioxide Price Forecast (link) • Xcel Energy, Direct Testimony by Jack Ihle on carbon prices, 2011 ERP (Docket 11A-869E) (link) • Colorado PUC Decision C13-0094, 2011 ERP (Docket 11A-869E) (link)

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