Economics of Proposed Biomass-fired District Heating System for Santa Fe, New Mexico

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Overview

What is the feasibility of building a biomass-fired district heating system in Santa Fe? Under a contract from the U.S. Department of Agriculture, Local Energy, a non-profit think tank based in Santa Fe, has prepared a detailed blueprint for such a system. This paper explores its public costs and benefits. The conclusion is that with expected rises in the price of natural gas, the project is well worth public funding.

A careful engineering study of the project, performed by the Austrian-based BIOS, estimates the construction cost at $23.5 million over a two-year period. Once operational, the facility would have annual costs, including financing, of $2.5 million. The delivered price of heat would be $16.63 per million British Thermal Units of energy (MM-BTU) – slightly higher than what users of natural gas from the local utility ($15.66/MM-BTU on an end-use basis), the Public Service Company of New Mexico (PNM), currently pay. These calculations show that the project, at least superficially, is not currently economic.

But most analysts believe that the price of natural gas will increase in the coming years, with the only real debate is over how high and fast that price rise will be. Just in the last two months, after Hurricane Katrina hit the Gulf Coast, natural gas prices nationally (Henry Hub) have jumped significantly higher, as much as 50 percent in some locales. Extrapolating from historic data since 1987, we foresee three plausible price-rise scenarios – a low scenario of 1.64% per year, a middle scenario of 5.13% per year, and a high scenario of 14.12% per year.

For purposes of this analysis, the "community" studied here is Santa Fe County. Even though the site of project itself is proposed for the city of Santa Fe, it will have implications on the regional economy and ecology, its "multiplier" benefits will be largely regional, and its principal investors may well be regional. The County better corresponds to this region than the City.

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There are many ways the project could be financed, but for simplicity, we assume that the County (and perhaps the City) provides a subsidy to all users of the biomass system so that their rates remain the same they would have been had they continued to use natural gas. As the price of natural gas rises, the subsidy diminishes and ultimately disappears.

Against the public costs of the subsidy must be weighed the public benefits. Two are particularly important: First, once the subsidy disappears, the County enjoys net savings by avoiding the importation of natural gas. Second, these savings, along with the construction expenditures on the biomass system, deliver significant "economic multiplier" benefits to the County economy. The latter benefits occur because only about 14.5 cents of every dollar expended by Santa Fe residents today on their natural-gas utility bill get re-spent within the County. Some 85.5 cents leaks out. With the proposed project, about 28 cents of every dollar would be expended locally within the County if industrial revenue bonds are used, and 51 cents if local financing is used. Because the biomass project keeps more energy dollars circulating in the local economy, it delivers a much higher multiplier than the current system run by PNM does.

Employing a discount rate of 2%, we examine the net public benefits of the project in six scenarios: the use of bond finance for the three projected price rises for natural gas; and the use of local finance for the same three price rises. The results are shown below.

Net Public Benefits of Proposed Project

	Annual Price Rise	**1.64%**	**5.13%**	**14.12%**
Bond Finance	Net Cost-Benefit (Discounted)	26,864,059	68,878,713	1,117,623,825
Local Finance	Net Cost-Benefit (Discounted)	49,193,878	91,208,531	1,139,953,644

In all six scenarios, the net benefits are positive, with benefits ranging from $27 million to $1.14 billion.

From a public policy standpoint, building the project immediately is sensible. Because the price of natural gas will rise under all six scenarios, the County will sooner or later have to begin a transition away this costly energy resource. The proposed project can be seen as a form of insurance, a hedge against the completely foreseeable risks of natural gas price rises. It demonstrates a locally rooted energy alternative that, over time, could be expanded to serve others in the region. If the County has to embark upon a transition away from dependency on shrinking and increasingly expensive natural-gas resources, it's wise to purchase rain gear and umbrellas, before the rainy season begins. As the devastation of Hurricane Katrina underscores, the modest price of diligent advance planning is well worth avoiding the horrendous costs of wishful thinking.

Real Costs

The price of natural gas facing residents and small businesses in Santa Fe right now is roughly \$11.23-\$12.39/MM-BTU, depending on the size and character (commercial vs. residential) of the customer.[2] Because the thermal efficiency of current systems converting the gas to usable heat is 75%, the effective price – that is, the price on an end-use basis –is \$14.97-16.53/MM-BTU. Based on the exact building mix in the proposed project site, Local Energy projects the average price for uses in the project area to be \$11.75/MM-BTU (or \$15.66/MM-BTU on an end-use basis).[3]

To arrive at a comparable price for the proposed district heating system, two sets of calculations are necessary – one for long-term capital costs, and the other for annual costs of fuel, operations, maintenance, and finance.

The Austrian architect-engineering firm BIOS estimated that the total capital cost of the system would be just under \$24 million. (For details on the capital costs, see Table 6.) We assume that one fifth of this amount is financed through private equity, and the remainder through debt – essentially 20% down.

One option is that with co-sponsorship by the County of Santa Fe and/or the City, the company running the district-heating system covers the debt with industrial development bonds (IRBs). The IRB Act in New Mexico authorizes counties and municipalities to issue such bonds for commercial and industrial projects that meet certain public objectives. The sponsoring government agency essentially acquires the project and then leases it back to private company. This exempts the project from *ad valorem* and property taxes, and also allows bondholders to claim the income-tax exemption for municipal bonds. When the debt is paid off, title transfers back in the company. At all times, however, the obligation to pay is carried exclusively by the beneficiary company.

In recent years the City of Santa Fe has issued IRBs for repayment periods of up to 30 years. Because most of the capital for the proposed project has a 50-year lifetime,[4] we assume that a 30-year bond is possible. One of the city's most recent IRB's was issued on behalf of the College of Santa Fe. The total bond was \$5.4 million, repayable over 24 years, to acquire, renovate, and expand classroom and teaching facilities. The interest rate was 5.5-5.75%. Because the Federal Reserve is expected to continue raising prime interest rates over the next year or so, we assume an interest rate of 6%.

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[2] Local Energy's calculation of the current price includes actual, announced, and projected prices from July 2005 to June 2006, thus reflecting the full variation of weather, use, and price that occurs in any given year. This price includes surcharges and delivery fees, but not meter fees or taxes.

[3] Most of the beneficiaries the project area turn out to be small-volume business users like hotels.

[4] While most public works projects have shorter lifetimes, the projected 50-year lifetime reflects actual experience with such systems in Western Europe. Much of the capital expenditure is for pipelines which, like water pipes, will not deteriorate quickly. And the boiler system is basic and simple. For those who believe a 30-year lifetime is more appropriate, keep in mind that the discounting applied substantially shrinks the costs and benefits in years 31 to 50.

Table 1 summarizes the assumptions on capital cost financing. It also shows that annual repayment burden will be just under $1.4 million.

Table 1
Summary of Financing for Project Capital Costs

Finance Overview

Total Investment	$23,532,165
Private Equity	$4,706,433
Debt Finance	$18,825,732

IRB Assumptions

Interest Rate	6.00%
Years of Maturity	30
Annual Payments	$1,367,669
Annual Interest Payments	$627,524

Table 2 presents the annual operating costs developed by BIOS. (For details on these annual expenses, see Table 8.) The cost of capital is roughly half of the annual expense; the rest is fuel, operations, and maintenance. This translates into a delivered price of heat of $16.63 /MM-BTU – slightly higher than what users of natural gas from the local utility, PNM, currently pay.

Table 2
Annual Operating Costs of Project

Capital	$1,367,669
Fuel	$556,640
Operations	$452,605
Maintenance	$282,958
Total Cost	$2,659,872
Delivered MM-BTU	159,900
Cost ($/MM-BTU)	$16.63

By these simple – and superficial – calculations, the proposed project is uneconomic. True, one could factor in environmental costs, which typically award bonuses to renewable energy sources (like biomass) over nonrenewable sources (like natural gas), but because natural gas is a relatively clean fuel, this bonus will be smaller than substitution of, say, heat from oil or coal-derived electric-resistance electricity.

Natural Gas Prices

A key factor in the economic feasibility of the proposed project is the price of natural gas. The faster and higher the price rises, the more quickly the proposed system becomes economically attractive.

Almost no credible projection of natural gas prices foresees a drop in the near future. A recent report from the National Petroleum Council concludes: "There has been a fundamental shift in the natural gas supply/demand balance that has resulted in higher prices and volatility in recent years. This situation is expected to continue, but can be moderated."[5] Between now and 2025, "[s]upply and demand will balance at a higher range of prices than historical levels."[6] Five reasons loom large:

First, in the past twenty years, the low-cost and low-pollution of natural gas has led to a huge expansion of its use. Between 1986 and 1997 overall demand in the country for natural gas has grown by 40%.[7] The number of residential customers grew from 48 million in 1987 to 60 million in 2001, industrial consumption grew by 48% during the same period, and roughly 90% of all new power plants were gas-burning.[8] The growing dependency of all sectors of society on natural gas will be difficult, and expensive, to reverse.

Second, North American gas fields will meet only three-quarters of anticipated demand in the near future.[9] Production from existing wells is dropping precipitously, at about 25-30% per year, so meeting even three-quarters of the demand over the next ten years will require wells that have not yet been drilled.[10] These newer wells will come from resources that are smaller, deeper, less permeable, and more expensive.

Third, the gap between supply and demand will have to be filled by more expensive resources coming via pipeline from Canada or through liquefied natural gas (LNG) shipments, and then pumped across the country through yet-to-be-build pipelines. All these projects – transnational pipelines, LNG terminals, and indigenous distribution upgrades – will likely meet, as they already have, significant pockets of resistance from grassroots groups concerned about the environmental, safety, and security implications of the projects, which will further escalate costs.

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[5] National Petroleum Council, "Balancing Natural Gas Policy—Fueling the Demands of a Growing Economy," Volume 1, Summary of Findings and Recommendations, 25 September 2003, p. 23.

[6] *Ibid*., p. 15.

[7] *Ibid*., p. 24.

[8] *Ibid*., p. 25.

[9] *Ibid*., p. 38.

[10] *Ibid*., p. 39.

Fourth, irrespective of the presence of new imports, the existing distribution system in the United States is aging and will require replacement. Over the next 22 years, some $70 billion will be required to upgrade pipelines, pumping, and storage facilities.[11] By 2020, nearly half of all expenditures in the industry will be needed for capital improvements.[12]

Finally, even the National Petroleum Council's optimistic scenario foreseeing only modest price rises imposes significant risks on the environment and public safety. It assumes many LNG terminals, intensified drilling off the Pacific and Atlantic Coasts, exploration of national parks and other areas now off limits, thousands of miles of new pipelines, and "streamlining" of multiple national, state, and local regulatory processes. These are all costs that the residents of Santa Fe County, many of whom view themselves as global environmental leaders, might deem unacceptable.

Outside analysts reading the report of the National Petroleum Council believe that the industry is effectively conceding that huge spikes in prices lie ahead. Andrew Weissman, publisher of EnergyBusinessWatch.com, says that the report "gives notice of a potentially severe crisis during the next 10 years that will not be eliminated even if Congress immediately enacts the federal energy legislations about to be sent to the floor of both Houses."[13] It "demonstrates beyond a shadow of a doubt that the supplies required to meet these projected needs won't be available. Instead, absent aggressive steps to reduce the amounts of natural gas needed to meet the needs of the U.S. economy during this period, a massive shortfall is inevitable."[14]

Even if the price of natural gas seems certain to rise, how large will that price rise be? What are plausible scenarios?

The U.S. Energy Information Administration has developed a database of monthly gas prices to U.S. residences going back to 1987. Table 3 presents the annual price of gas in real 2002 dollars, up until mid-2005.[15] Each annual price is derived from a weighted average of monthly data, which vary quite significantly within any given year, and the weights of which are based on actual monthly use patterns in Santa Fe calculated by Local Energy. Generally, the trends show the nominal price of natural gas falling until 1995, and then rising sharply, ultimately well above the 1987 level.

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[11] *Ibid*., p. 51.

[12] *Ibid.*

[13] Andrew Weissman, "Puncturing Natural Gas Myths – Part I," 21 November 2003, posted on www.energypulse.net.

[14] *Ibid.*

[15] Projections must be made for the second half of 2005, since EIA data are not available yet. For July-September 2005, mid-month spot prices at the Henry Hub are used. For November and December, advanced contracts on the NYMEX are used.

Table 3
Historical Residential Natural Gas Prices (2002$/MM-BTU)

Year	Average Price
1987	$8.60
1988	$8.19
1989	$8.03
1990	$7.84
1991	$7.53
1992	$7.42
1993	$7.54
1994	$7.64
1995	$6.98
1996	$7.15
1997	$7.64
1998	$7.36
1999	$7.11
2000	$7.98
2001	$9.41
2002	$7.75
2003	$9.27
2004	$10.14
2005	$11.52

We see three plausible scenarios that can be extrapolated from these data, as show in Table 4.

Table 4
Plausible Growth Rates of Natural Gas Prices

Period	Annual % Rise
1987-2005	1.64%
1995-2005	5.13%
2002-2005	14.12%

The most modest extrapolation, of 1.64% per year, comes from the entire period of 1987 to 2005. This may also be the least defensible, since most of this period reflected a period of expanding supply that has come to an end. Starting in mid-1990s has been a growing awareness that supplies of natural gas are running out and that major new finds are unlikely. Extrapolating the growth of the curve since the mid-1990s produces an annual price growth rate of 5.13%. Even this calculation, however, may prove overly optimistic, since some analysts argue that the price of natural gas, once the reality of diminishing supplies sinks in, could rise quite dramatically. Over the past three years, the price has risen 14.12%.

These three scenarios form the basis for our projections.

Multiplier Benefits

Whenever a governmental entity undertakes a project, the costs and benefits to everyone living under its jurisdiction need to be evaluated.[16] In the case of energy projects, where the status quo requires importation of outside resources, perhaps the most significant factor is the economic multiplier.

The economic multiplier is a key factor in community economics: Each time an individual purchases a good or service, he or she sets in motion ripples far beyond the initial transaction. And the more frequent and intense those ripples within a defined economic system, the stronger that system is. Consider a consumer in New Mexico who buys an apple for a dollar from a farmer in Washington state via mail order. That farmer, in turn, may use that dollar to buy toothpaste at a nearby store. The store owner then might use the same dollar to pay an employee who spends the dollar at a local bookstore. In this way the initial transaction cascades into a series of transactions that reverberate throughout a community economy.

From the perspective of a locality, a key to prosperity is to keep as much of the multiplier within the community as possible. In the example above, the consumer in New Mexico, as well as his neighbors, may be better off if he buys the apple from a local farmer. To the extent that all the resulting transactions – the toothpaste purchase, the employee pay, the bookstore expenditure – are kept within New Mexico, the entire state experiences more jobs, income, and wealth.

Keeping the multiplier local also benefits state and local taxing authorities. The transactions from a mail-order purchase of an apple will boost the tax base in Washington state, which will be able to tax the consequent increases in wages, income, property value, and sales. The transactions from a local purchase of an apple, in contrast, will enrich the tax base of New Mexico. Because taxes usually lead to public expenditures, they too exert a multiplier effect.

Several recent studies have underscored that local expenditures have a significantly higher multiplier than nonlocal expenditures. For example, a study done by Civic Economics in 2003 found that every $100 spent at a planned Borders bookstore in Austin, Texas, would lead to $13 being respent into the local economy. The expenditure of $100 at two local bookstores, in contrast, would circulate $45, roughly three times the

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[16] The cost-benefit evaluation here looks at aggregate costs and benefits within Santa Fe County. No attempt is made to define whether the County and City government budgets would come out ahead – that is, whether tax proceeds from the project exceed public expenditures for the project. In all our scenarios, however, local government appears to be a winner.

Consider the lowest benefit scenario, associated with a 1.64% per year price rise and nonlocal financing: According to the 2005 edition of *Statistical Abstract*, local governments in New Mexico in the year 2000 collected directly about $1 billion in taxes (Table 443) from a statewide output of $52.6 billion (Table 645) – or an effective tax rate of 1.9% (accounting for intergovernmental transfers to local government would increase this percentage). For net benefits of $27 million, the increment in local taxes would be about $500,000, more than the $370,000 subsidy required.

multiplier. Similar studies in the United States and the United Kingdom confirm that local expenditures contribute two to three times the multiplier as nonlocal expenditures. The reason is simple: Local businesses spend more money locally – on local management, local services, local advertising, and local profits.

While New Mexico produces natural gas, Santa Fe County and City do not. Consequently, as the price of natural gas rises, more and more dollars are exported out of the immediate region, with a consequent loss of multiplier.

To determine the multipliers resulting from both existing natural gas expenditures and those of the proposed project, we used the RIMS-II database, which is available from the U.S. Bureau of Economic Analysis. Multiplier models like RIMS-II typically require the plugging in of an expenditure (or loss of an expenditure), and then predict the short-term and long-term changes in earnings, output, and jobs within a defined geographic area. The models are based on broad assumptions and aggregate data, and their builders turn out to know very little about the degree of localization of any given firm's or industry's expenditure.

The best use of multiplier models is to develop as much specific data for a community as possible, and then to apply the model to what remains unknown. Accordingly, we first estimate how much a Santa Fe resident's utility dollar, the "first-round expenditure," stays inside the community, with and without the district heating project, and apply the RIMS-II multiplier only to the utility's and the project's "second-round expenditure." The local expenditures of alternatives are then credited with appropriate multipliers for the sector, while nonlocal expenditures receive no multiplier credit.

In Table 5, we ascertain which expenditures from the state utility, PNM, are local. The expenditures are from PNM's 10-K filing to the U.S. Securities and Exchange Commission in 2003. We then estimate how much of each category comes from outside the County. Natural gas, as noted, comes entirely from outside Santa Fe County (though potentially from elsewhere in New Mexico). Virtually all the administration and corporate expenditures are concentrated in Albuquerque, but we assume that 25% remains local in the form of basic maintenance work and other house calls. We similarly assume that 25% of the depreciation and amortization comes from local buildings, pipelines, pumping stations, and other capital expenditures. Because transmission is nonlocal but distribution is local, we assume that 75% of the "T&D O&M" line item is localized. The only expenses which are arguably 100% local are for customer services and non-income taxes. Altogether, these assumptions suggest that 14.5 cents of every natural gas dollar spent by Santa Fe consumers gets re-spent locally.

Table 5
Local Character of PNM Natural Gas Expenditures Based on Statewide Expenditures in 2003
($1,000)

	Total Expenditures	% Local	Local Expenditures
Cost of Energy	$228,345	0%	$0
Energy Production	$1,930	0%	$0
T&D O&M	$29,515	75%	$22,136
Customer-Related Expense	$16,832	100%	$16,832
Administrative & General	$2,040	25%	$510
Corporate Allocation	$40,363	0%	$0
Depreciation & Amortization	$22,186	25%	$5,547
Taxes (non-Income)	$6,886	100%	$6,886
Income Taxes	-$1,281	0%	$0
Earnings	$11,451	0%	$0
Total Revenue	$358,267		$51,911
		% Local	14.49%

In Tables 6, 7, and 8 this exercise is performed for the proposed district heating project, for construction costs, for fuel costs, and for annual operations:

- Regarding capital costs (Table 6), most of the materials for the project come from outside the county, but much of the labor to install it can be local. Approximately 24% of the total construction costs are localized.

- Regarding fuel costs (Table 7), approximately a third of the required annual biomass can come from inside the county. This number is entered into Table 8, on annual operation costs.

- And regarding operations (Table 8), labor is local but most spare parts are non-local. Roughly 57% of the expenses thus wind up being localized.

Table 8, however, is incomplete in one respect, in that it does not include loan repayments. On the assumption that residents of the County do not snap up the IRBs disproportionately (arguably they could be convinced to do so out of project and community loyalty), Table 9 shows that, in aggregate, 28% of annual expenditures are localized. It's noteworthy that were some combination of the County, the City, and residents to fund the project themselves, the localization of interest payments would raise the overall level of annual localization of annual expenditures to 51%.[17]

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[17] Principal payments are not typically counted as part of "final demand," the driving factor of the RIMS-II model. Multiplier impacts of the initial investment are captured in the one-time multiplier calculations associated with construction.

Table 6
Local Character of Capital Costs

	Investment	% Local	Local Spending
Network of Pipes			
Pipes	$8,118,000	0%	$0
Trenching/Backfilling	$2,806,800	100%	$2,806,800
Heat Transfer Stations	$3,229,245	0%	$0
Mechanical Equipment			
Combustion and Boiler	$1,812,000	0%	$0
Flu Gas Cleaning	$1,495,200	0%	$0
Ash Removal & Storage	$224,400	50%	$112,200
Heat Recovery	$243,600	0%	$0
Fuel Feeding	$217,200	0%	$0
Cranes	$103,680	100%	$103,680
Electric Installations	$714,864	100%	$714,864
Hydronic Installations	$943,488	100%	$943,488
Steel Construction	$291,600	50%	$145,800
Peak Load Coverage	$520,800	0%	$0
CHP-Module			
Other			
Vehicles	$120,000	50%	$60,000
Engineering	$2,091,288	25%	$522,822
Miscellaneous	$600,000	50%	$300,000
TOTAL	$23,532,165		$5,709,654
		% Local	24.26%

Table 7
Local Character of Annual Biomass Used

	Tons/Year	BTUs/Ton	MM-BTUs
Commercial Green Waste			
Norton Hill Wood Co	50	5,381	538
Hansens Lumber	50	5,381	538
Spotted Owl Timber	3,500	5,381	37,667
Alpine Builders Supply	100	5,381	1,076
Thinning			0
Glorieta, La Cueva, & Apache Canyon	2,134	6,129	26,152
Totals	5,834		65,972
	Total Req.		197,164
	% Local		33.46%

Table 8
Local Character of Annual Operations Costs

	Maintenance Costs	Consumption Costs	Operation Based Costs	Total Costs	% Local	Total Local Expenditure
Construction Costs						
Building						
Storage Area	$2,400			$2,400	100%	$2,400
Outside Facility						
Infrastructure						
Network of Pipes						
Pipes	$40,590			$40,590	0%	$0
Trenching/Backfilling	$14,034			$14,034	100%	$14,034
Heat Transfer Stations	$64,585			$64,585	0%	$0
Mechanical Equipment						
Combustion and Boiler	$54,360			$54,360	0%	$0
Flu Gas Cleaning	$29,904			$29,904	0%	$0
Ash Removal & Storage	$6,732			$6,732	100%	$6,732
Heat Recovery	$4,872			$4,872	0%	$0
Fuel Feeding	$6,516			$6,516	0%	$0
Cranes	$2,074			$2,074	100%	$2,074
Electric Installations	$14,297			$14,297	100%	$14,297
Hydronic Installations	$18,870			$18,870	100%	$18,870
Steel Construction	$2,916			$2,916	50%	$1,458
Peak Load Coverage	$5,208			$5,208	0%	$0
CHP-Module						
Other						
Vehicles	$3,600			$3,600	50%	$1,800
Engineering				$0	0%	$0
Miscellaneous	$12,000			$12,000	50%	$6,000
Fuel Costs						
Biomass		$355,466		$355,466	33%	$118,940
Natural Gas		$107,514		$107,514	0%	$0
Other O&M Costs						
Labor Costs			$171,000	$171,000	100%	$171,000
Electricity		$93,660		$93,660	100%	$93,660
Other Costs (Material Expenses)			$166,405	$166,405	100%	$166,405
Additional Operating Costs			$109,200	$109,200	100%	$109,200
Operational Supplements CHP						
Rental Fee (Property)			$6,000	$6,000	100%	$6,000
TOTAL	$282,958	$556,640	$452,605	$1,292,203		$732,870
					% Local	56.71%

Table 9
Local Character of Annual Project Expenditures

	Total Expend.	Local Expenditure	
		Bond Finance	Local Finance
Finance Payments	1,367,669	0	627,524
Operations	1,292,203	732,870	732,870
Total Cost	2,659,872	732,870	1,360,395
	% Local	27.55%	51.15%

Comparing the lower estimate in Table 9 (27.55% local) with Table 5 (14.49% local) suggests that every dollar reallocated from PNM to a district heating system will contribute about 13 cents more into the local economy. The multiplier for the "electricity, gas, and sanitary services" sector, in the RIMS-II database, is 2.2. Therefore, every dollar reallocated ultimately yields 26 cents (13 times 2.2) more output in Santa Fe County.

Additionally, the County will enjoy a one-time benefit from construction of the facility. The $5.7 million expended locally on construction will yield for the County, over the two year period, $8.1 million in additional output, $1.8 million in additional earnings, and 72 jobs.

This multiplier analysis, however, is more accurate for PNM than for the proposed biomass system. The reason is that the RIMS-II model reflects the current composition of the economy, including PNM's actual expenditures. Using the utility sector multiplier therefore is sensible. To evaluate the expenditures of the proposed project, one must look more closely at the actual local spending. For maintenance and some operations, the utility sector multiplier makes sense. For local biomass fuel, the more appropriate sector is "Forestry and Fishing Products." And for local finance, the more appropriate sector is "Depository and Nondepository Institutions."[18] The calculations in Table 10 suggest that the more appropriate multiplier for local project spending is 2.01 if the debt is covered through IRBs, and 1.97 if the finance is localized.

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[18] As noted earlier, the only part of annual finance payments that increases local demand is interest, and then only if the interest is paid to local lenders. Increased demand from principal payments is already accounted for in the construction expenditures and the related multiplier. The use of "Depository and Nondepository Institutions" as the multiplier category is really a stand in for the impact of interest payments generally. Were "State and Local Government Enterprises" to finance the project, without any banking intermediaries, the more appropriate multiplier would be a bit lower, at 1.66.

Table 10
Adjusted Biomass Multipliers

	Local Expenditures		Multipliers
	Bond Finance	Local Finance	
Operations	613,930	613,930	2.21
Fuel	118,940	118,940	1.62
Interest Payments		627,524	1.81
	732,870	1,360,395	

Weighted Average Multipliers

Bond Finance	2.01
Local Finance	1.97

Long-Term Benefits of Project

The final task is to examine the long-term benefits of the project under three different scenarios of rising natural gas prices. Many methodologies are plausible for performing a cost-benefit analysis. We choose a relatively simple one, with five key items:

- *Avoided Gas Expenditures* – We credit the County with all avoided expenditures to PNM.
- *Avoided Gas Expenditure Multipliers* – We debit the County all the local multiplier benefits that would have been enjoyed had the gas expenditures been made.
- *Actual Biomass Expenditures* – We debit the County all the costs paid to build and operate the biomass system.
- *Biomass Expenditure Multipliers* – We credit the County with all the local multiplier benefits enjoyed because of the biomass expenditures.
- *Subsidies* – We debit the County all subsidies made.

The results, over the 50 year lifetime of the project, are shown in Table 11.

Table 11
Total Benefits of Project

Annual Price Rise	**1.64%**	**5.13%**	**14.12%**
Cumulative Gas Expenditures	191,782,108	547,653,819	13,076,393,148
Cumulative Multiplier Benefits	(61,133,782)	(174,573,893)	(4,168,320,907)
Cumulative Biomass Expenditures	(132,993,597)	(132,993,597)	(132,993,597)
Cumulative Multiplier Benefits	81,886,362	81,886,362	81,886,362
Cumulative Project Benefit	79,541,091	321,972,690	8,856,965,006
Cumulative Subsidy	369,843	180,923	154,772
Net Cost-Benefit	**79,171,247**	**321,791,767**	**8,856,810,234**

Under the most conservative scenario of rising natural gas prices, at 1.64% per year, the government winds up paying $370,000 in subsidies, but generates County-wide net benefits of $79 million. In the other two scenarios, the County comes even further ahead. In the middle scenario, under the assumption of an annual price rise of 5.13%, the government subsidy goes down to under $180,000 and residents come out $321 million ahead. And in the worst case scenario, with an annual price rise of 14.12%, the government subsidy is reduced to $155,000 and net benefits are nearly $9 billion.

One adjustment arguably necessary is to discount the stream of benefits and costs. We say “arguably,” because a real discount rate should reflect the time cost of money, without inflation and without risk, and empirical studies of government bonds and the highest grade industrial bonds suggest the real cost of money is very close to zero.[19] Our analysis already has factored out inflation (the price-rise scenarios all reflect real cost-rise patterns), so the discount rate, from this perspective, should be zero. Even looking at the short-term cost of money, the Federal Reserve currently sets the prime rate at 4.00%, while the annualized inflation rate is now 4.69% (driven recently by rising oil prices).

Were the Federal Reserve to raise interest rates another 2% or so, as some anticipate, and were the rate of inflation to remain the same, a discount rate as high as 2% might be defensible. As Table 12 below shows, such a discount rate reduces the net benefits, as one might expect, but does not change the bottom line – that the project generates net income for the County in all three scenarios.

Table 12
Undiscounted vs. Discounted Benefits

Annual Price Rise	**1.64%**	**5.13%**	**14.12%**
Net Cost-Benefit (No Discount)	79,171,247	321,791,767	8,856,810,234
Net Cost-Benefit (Discounted)	26,864,059	68,878,713	1,117,623,825

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[19] Ralph Cavanagh et al., *Pacific Northwest Model Energy Plan*, (San Francisco: Natural Resources Defense Council, 1981).

The Role of Local Finance

The calculations above all assume traditional IRB finance for 80% of the capital requirements. As noted earlier, however, financing the project locally dramatically increases the multiplier impact. Table 13, below, shows the effect on discounted net benefits if the source of the finance and the destination of the interest payments are localized.

Table 13
Bond vs. Local Finance (Discounted)

Annual Price Rise	1.64%	5.13%	14.12%
Net Cost-Benefit (Local Finance)	26,864,059	68,878,713	1,117,623,825
Net Cost-Benefit (Discounted)	49,193,878	91,208,531	1,139,953,644

In all three scenarios, the higher multiplier impact of the biomass project adds about $23 million of discounted benefit to the region. The recycling of interest payments significantly boosts local economic activity.

To accomplish this, some combination of County and City government could underwrite and own the project as a municipal corporation. These entities also could then privatize the company by giving stock to every resident, ensuring that the benefits of the project were shared equally. Alternatively, local private financiers, perhaps banks, could play a leading role. The important point is the project becomes more lucrative if financing is kept local.

Timing

This analysis suggests that in all plausible scenarios, the project makes sense. Any delay, moreover, reduces net benefits, since Santa Fe residents increasingly will lose income to non-local natural gas imports.

Only if one believes that the price of natural gas will rise more slowly than the lowest scenario or even, perhaps, decline, should Santa Fe defer moving on the project. Additional information about gas prices over the next year or two should clarify decisively whether this analysis, and the recommendations that flow from it, are reasonable.

A Word on Methodology

There are many kinds of costs and benefits that are not included in the analysis above, nearly all of which would increase the net benefit for biomass:

- We did not evaluate the environmental costs of the alternatives, including carbon credits, though there is a evidence that renewable biomass resources damage the environment less than nonrenewable natural gas resources.

- We did not evaluate the “national security” cost associated with increasing dependency of natural-gas imports.

- We did not evaluate the hidden costs that natural gas users will face as prices rise, including fuel switching, lost business, significantly lower disposable income, higher government welfare payments, and a wide range of social costs that will result from any energy “shock.”

- We did not estimate potential cost escalation of either system, even though it is clear that massive new costs will be needed to distribute natural gas, while the technology for biomass district heating, as it comes into wider use and parts become mass produced, could actually go down.