



The Economic Impact of Infrastructure Improvements
Proposed by the Connecticut Light and Power Company

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Executive Summary

Connecticut Light and Power (CL&P) asked the Center for Economic Analysis (CCEA) at the University of Connecticut to assess the economic impact of distribution infrastructure improvements in its pending rate case. The proposed project improves the distribution infrastructure in CL&P's service area providing increased quality and reliability of delivered electric power. These improvements come at a time when Connecticut's aging distribution infrastructure needs to deliver higher quality electric power to increasingly sensitive manufacturing processes and to more information technology hardware in homes and offices than ever before. One view of this situation is that Connecticut's economic future crucially depends on the availability of high quality electric power, and, indeed this is a competitive issue among the states. Connecticut's electricity distribution infrastructure is similar in its ability to affect costs and relocation and expansion decisions just as does its transportation and communication infrastructure.

Using data provided by CL&P in its rate case filing and a report by the Electric Power Research Institute (EPRI)¹ that analyzed net business costs associated with reliability improvements, CCEA estimates the net economic benefit of the proposed improvements. CCEA estimates as well the economic situation were the proposed improvements not done in which case current infrastructure would deteriorate despite current maintenance level investment. CCEA uses the Connecticut economic model embodied in REMI², a tool widely recognized and used by the State of Connecticut.

If CL&P makes no improvement to the distribution infrastructure, then on average in any given year between 2004 and 2014 (values are typically higher in 2004 and lower in 2014):

- Business costs increase \$300 million³
- Connecticut loses more than 3,400 jobs
- Connecticut loses more than \$388 million in gross state product (GSP)⁴

¹ "The Cost of Power Disturbances to Industrial & Digital Economy Companies," June 2001. Available at www.epri.com/ceids.

² From Regional Economic Models, Inc. of Amherst, Mass. The Appendix contains a description of the model.

³ All money values expressed in 2001 dollars, that is, adjusted for inflation.

- Connecticut loses more than \$189 million in personal income⁵
- Connecticut loses more than \$44 million in state tax revenue
- Connecticut loses more than \$16 million in municipal tax revenue

If CL&P makes the proposed improvements to the distribution infrastructure, then on average in any given year between 2004 and 2014 (values are typically lower in 2004 and higher in 2014):

- *Business costs decrease \$621 million*
- *Connecticut gains more than 6,500 jobs*
- *Connecticut gains more than \$616 million in new gross state product (GSP)*
- *Connecticut gains more than \$392 million in new personal income*
- *Connecticut gains more than \$68 million in new state tax revenue*
- *Connecticut gains more than \$50 million in new municipal tax revenue*
- *Each dollar of the proposed rate increase returns \$3.40 to Connecticut in new GSP*
- *Each dollar of the proposed rate increase returns \$2.20 to Connecticut in new personal income*

⁴ GSP measures the value of all goods and services produced in the state in a year.

⁵ Personal income is income from all sources for all residents before taxes.

Introduction

Connecticut Light and Power (CL&P) asked the Center for Economic Analysis (CCEA) at the University of Connecticut to assess the economic impact of distribution infrastructure improvements in its pending rate case. The proposed project improves the distribution infrastructure in CL&P's service area providing increased quality and reliability of delivered electric power. Improvements consist of the installation of new equipment and distribution lines in neighborhoods and in their substations. Improved quality means delivered power is fraught with fewer low voltage episodes, fewer surges and better line balance. Improved reliability means fewer outages. These improvements will save businesses and homes money, but will materialize at a cost embodied in a rate increase. These improvements come at a time when Connecticut's aging distribution infrastructure needs to deliver higher quality electric power to increasingly sensitive manufacturing processes and to more information technology hardware in homes and offices than ever before.

The proposed project invests an average \$165 million more than the no-action case each year for five years in making these improvements. The 'no-action' case is the situation in which CL&P makes its maintenance investments without net improvements to the existing distribution infrastructure. In this case, the investment will not prevent further deterioration of equipment some of which is on average 40 or more years old. CL&P will spend most of the construction outlays in Connecticut employing Connecticut workers and buy Connecticut made materials wherever possible. CL&P will hire additional workers to perform upgrade and maintenance work on the new system. The improvements to town properties on which CL&P operates will increase local tax revenues. Firms will realize lower production costs due to fewer outages and higher electric power quality. Their sales and profits will increase and they will pay more taxes. All electricity users in CL&P's service area will experience a rate increase that averages \$156.4 million over the ten-year horizon of this study. Thus, the resulting economic impact measures the aggregate *net* economic benefit (or loss) due to the project. We do not consider the cost savings to households and therefore our analysis is conservative. In this assessment, we do not consider the costs of the inconveniences during construction (short-term consequences) or the improved attractiveness of the region (long-term consequences) due to the proposed improvements.

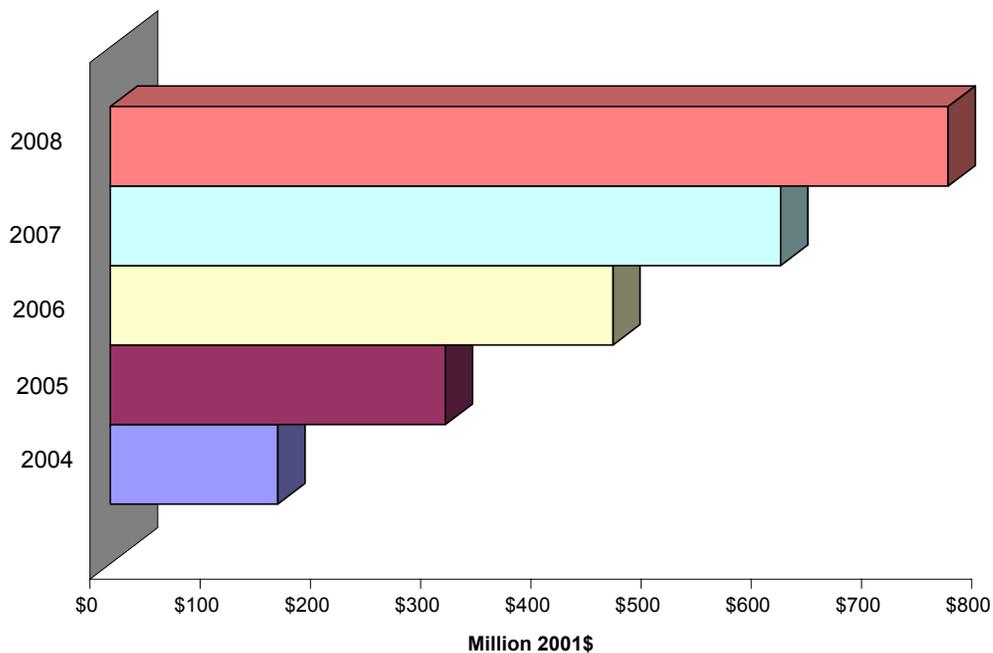
Data and Assumptions for Realizing Proposed Improvements

CL&P provided employment, construction costs, the market value of property improvements, and rate increase data. CL&P derived business gains and losses from the Electric Power Research Institute's (EPRI) 2001 study⁶ that analyzed net business cost savings due to quality and reliability improvements. In deriving production cost savings, CCEA uses the average of the high and low scenario values from the EPRI report. In moving from savings in minutes to savings in dollars, we assume a linear relationship. For continuous manufacturing processes, this seems to be a reasonable assumption. For individuals whose lost time directly converts to dollars, this seems to be a reasonable assumption. CCEA approximates lumpy, batch processes by the same linear relationship. CCEA distributes these production cost savings across all commercial and industrial sectors (excluding the household and public sectors) according to their electrical power usage and gross receipts shares. Figure 1 shows the aggregate net gains to businesses in each year during the construction phase. These gains (production cost reductions), in inflation adjusted terms, continue into the future because this analysis assumes CL&P will maintain them with its ongoing franchise capital commitment adjusted for inflation. The horizon for this analysis is ten years such that after four years of construction there are no anticipated rate changes or additional distribution infrastructure improvements, in other words, CL&P enters into a maintenance mode. The quality and reliability improvements remain at their 2008 levels with the franchise or maintenance investment for at least ten years after which we anticipate some deterioration in the equipment.

⁶ "The Cost of Power Disturbances to Industrial & Digital Economy Companies," June 2001. Available at www.epri.com/ceids.

Figure 1

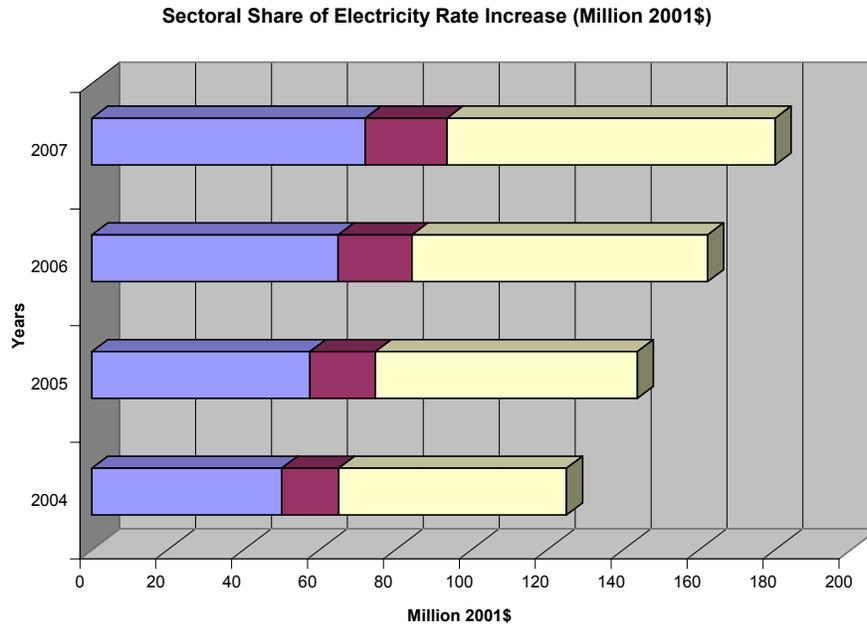
**Net Business Gains Due to Electricity Distribution Infrastructure Improvements
(2004-2008)**



The rate increase necessary to support the improvements will be levied on all CL&P customers in its service area. Figure 2 shows the sectoral breakdown of the rate increase. This graph shows the increase each year above the *no-action* case. That is, the initial rate increase in 2004 is \$125 million in 2001 dollars. The rate increases by \$19 million in 2005 to \$144 million more than the no-action case, and so on.

Table 1 reports the timeline of construction costs, employment gains and rate increases for the proposed project. These variables except for construction (which ceases) remain at their 2008 values through 2014 and drive the REMI analysis. We assume CL&P will hire *net* new workers *to install and maintain the new infrastructure* in each of three years beginning in 2004 as reported in Table 1. In 2007, the cumulative new employment (a total of 84 new workers) will continue at its 2007 level for at least seven more years because implicit in the baseline forecast for the Connecticut economy is attrition (these workers are net new). For economic modeling purposes only, we use the anticipated wage of these workers instead of the average public utility sector wage in the REMI model. This enhancement is appropriate because CCEA knows the anticipated CL&P wage. Therefore, we adjust the wage bill, which is the product of the wage rate difference between REMI's forecast public utility sector average wage and the CL&P wage, and, the new CL&P

Figure 2



	2004	2005	2006	2007
Residential	60.0	69.0	77.9	86.4
Industrial	15.0	17.2	19.5	21.6
Commercial	50.0	57.5	64.9	72.0

employment in each year. We assume that construction ceases in 2009 and that the rate increase remains at its 2008 level adjusted for expected inflation through 2014. Production cost reductions remain at their 2008 levels through 2014 adjusted for inflation.

New property taxes accrue to towns due to the improvements CL&P makes on its properties as reported in Table 1. The rate increase distributes across user categories according to CL&P's forecast of 40% commercial, 12% industrial and 48% residential.

Table 1

REMI Input Categories and Assumptions					
Category	2004	2005	2006	2007	2008
Construction (million 2001\$)	\$153	\$164	\$167	\$132	\$132
Business Gains (million 2001\$)	\$152	\$304	\$456	\$608	\$760
Employment FTE (New)	46	83	84	84	84
Wage Bill Adjustment (2001\$)	\$455,962	\$836,938	\$858,037	\$870,927	\$870,927
Rate Increase (Million 2001\$)	\$125	\$144	\$162	\$180	\$180
Commercial	\$50	\$57	\$65	\$72	\$72
Industrial	\$15	\$17	\$19	\$22	\$22
Residential	\$60	\$69	\$78	\$86	\$86
Property Tax (million 2001 \$)	\$6	\$11	\$17	\$23	\$23

The following four pie charts indicate which industrial sectors benefit in terms of reduced production costs from the CL&P proposed distribution infrastructure improvements.

Chart 1

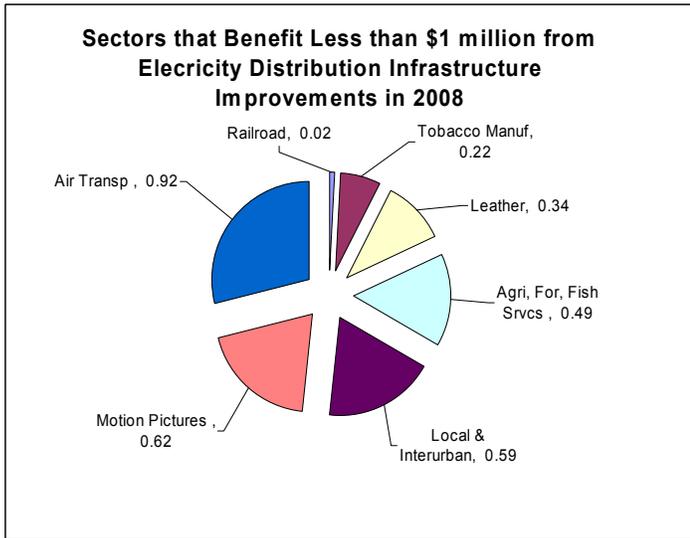


Chart 2

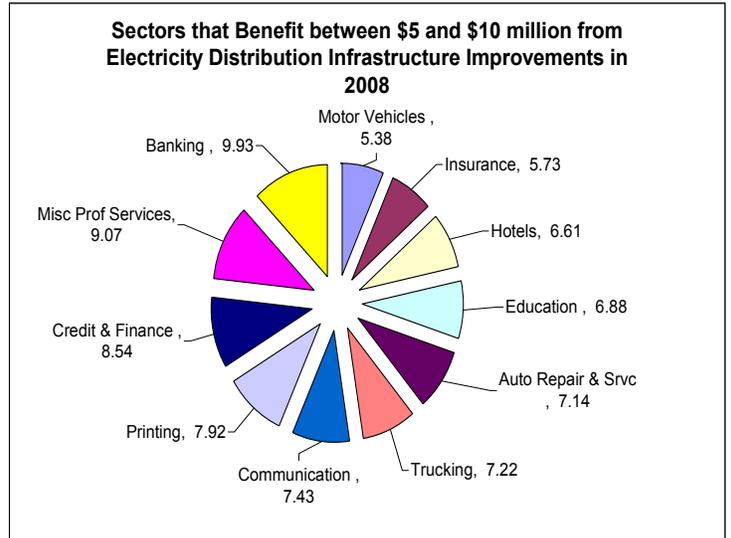


Chart 3

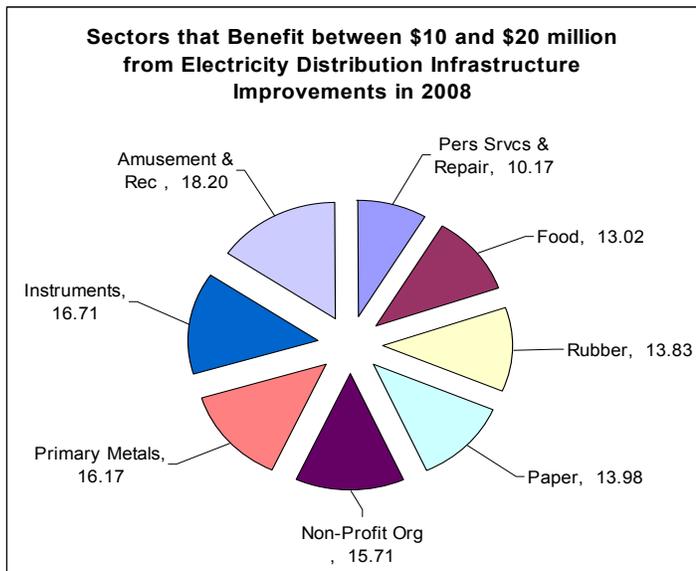
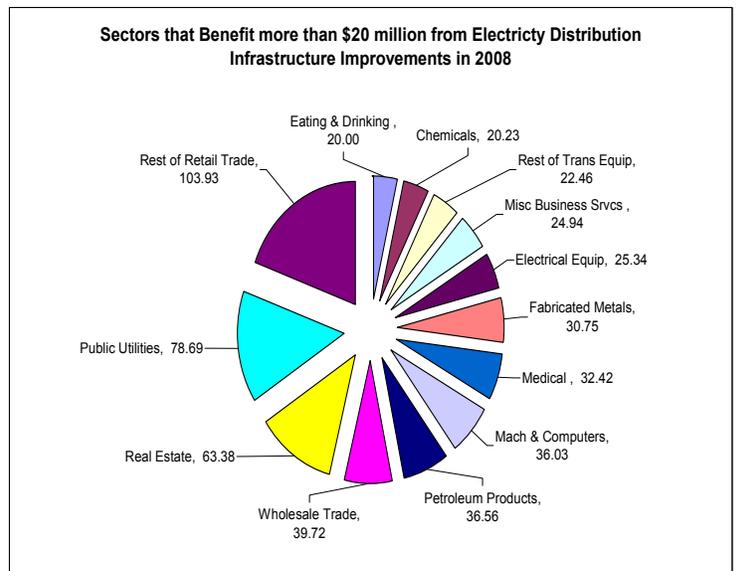


Chart 4



Modeling Strategy

CCEA uses the Connecticut economic model REMI developed by Regional Economic Models, Inc. of Amherst, MA to derive the impact due to the proposed project (see Appendix for a description of this model). Construction costs in the electrical facilities category, new employment in the public utilities sector, reduced production costs allocated to 49 (2-digit) industrial sectors, new local tax revenues offset by new local government expenditures (governments do not save) are the positive shocks driving the economic impact. The rate increase modeled as increased fuel costs in the commercial and industrial sectors and modeled as increased household expense for ‘fuel’ are the negative shocks. As explained above, for economic impact modeling purposes only, we adjust the wage bill in the public utilities sector to reflect anticipated CL&P wages.

Economic and Fiscal Results of Realizing Proposed Improvements

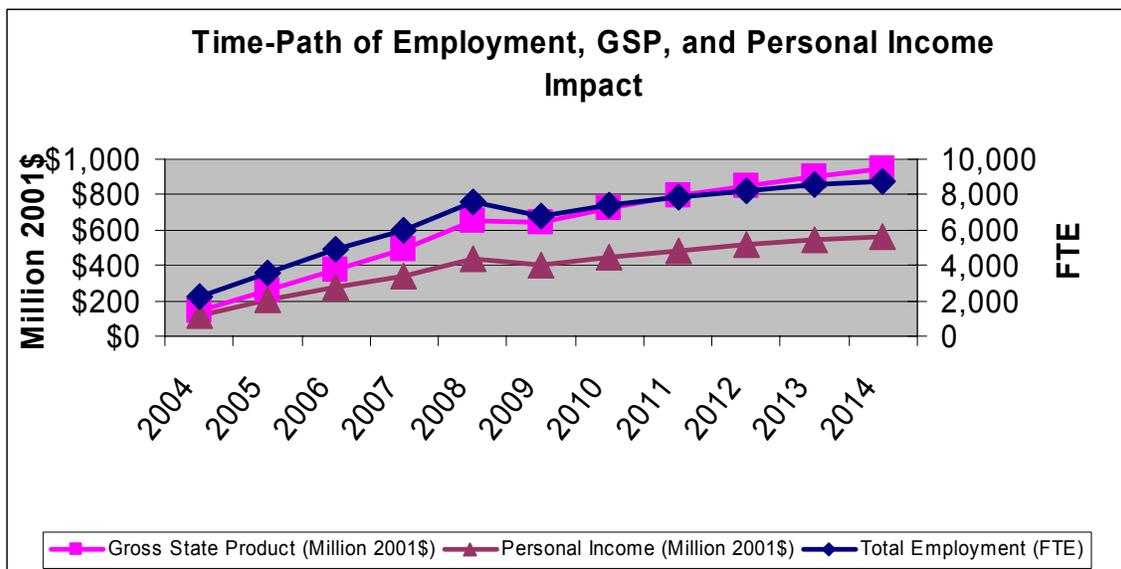
CCEA’s reported results reflect the *net* economic benefit of the proposed improvements. They represent the total effect of the changes (shocks) described above, that is, they represent the sum of the direct, indirect and induced effects. We report results as changes above the baseline or no-action case for selected years, as well as average employment, personal income and gross state product (GSP) increases and the net present value of monetary quantities. The net present value is the stream of annual changes in a monetary quantity discounted to the present at 6.5%. Table 2 reports results for employment, GSP and personal income. GSP represents the value added of all goods and services produced in Connecticut in one year. The average annual increase in GSP is more than \$600 million, while the average annual increase in personal income is slightly less than \$400 million. Total employment in Connecticut increases more than 6,500 jobs in any given year on average. Net present value for GSP over the ten-year horizon is almost \$4.4 billion and for personal income, the net present value is more than \$2.8 billion.

Table 2

CL&P: Economic Impact of Distribution Infrastructure Improvements (2004-2014)									
Impact Category	2005	2006	2008	2009	2011	2012	2014	Average	Net Present Value
Total Employment (FTE)	3,578	4,930	7,614	6,822	7,892	8,242	8,736	6,544	
Gross State Product (Million 2001\$)	\$260.02	\$378.46	\$650.30	\$644.45	\$791.06	\$845.73	\$943.51	\$616.34	\$4,355.55
Personal Income (Million 2001\$)	\$201.19	\$277.52	\$434.82	\$401.45	\$483.37	\$514.41	\$562.46	\$392.67	\$2,814.33

Figure 3 shows the dynamics of GSP, personal income and new employment in Connecticut over the period 2004 through 2014. The dip in employment after 2008 reflects the cessation of construction.

Figure 3



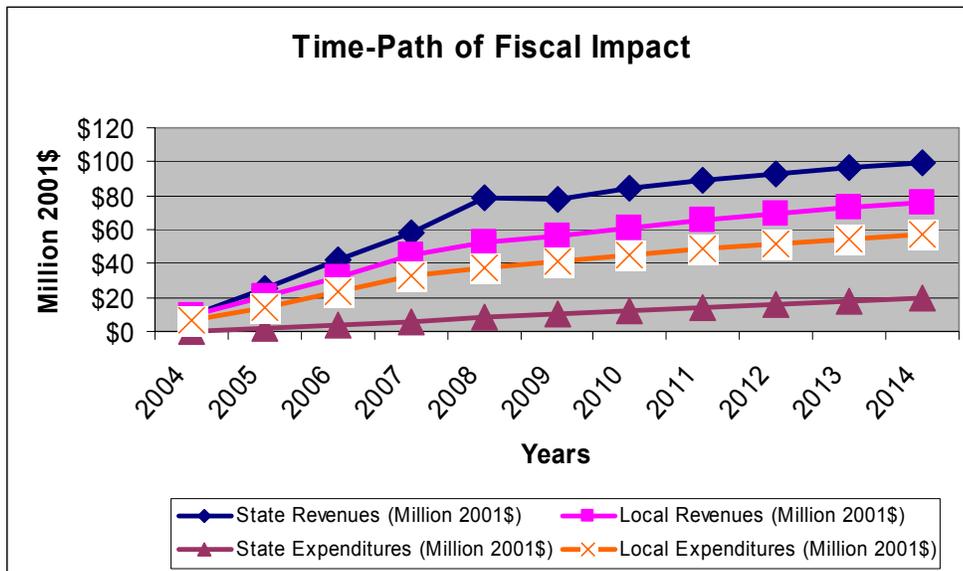
As a result of the improvements to CL&P’s property, local taxes and expenditures increase. Increased total employment and sales due to lower production costs induces increased sales and income taxes that accrue to the state. Table 3 reports the state and local fiscal results due to the proposed improvements.

Table 3

CL&P: Fiscal Impact of Distribution Infrastructure Improvements (2004-2014)									
Impact Category	2005	2006	2008	2009	2011	2012	2014	Average	Net Present Value
State Revenues (Million 2001\$)	\$25.31	\$41.90	\$79.15	\$77.46	\$89.17	\$93.27	\$99.25	\$68.45	\$483.16
Local Revenues (Million 2001\$)	\$20.16	\$32.22	\$52.41	\$56.41	\$65.30	\$69.28	\$76.27	\$50.88	\$359.55
State Expenditures (Million 2001\$)	\$1.65	\$3.46	\$8.38	\$10.63	\$14.46	\$16.21	\$19.29	\$10.05	\$67.70
Local Expenditures (Million 2001\$)	\$14.33	\$23.20	\$37.50	\$41.53	\$48.42	\$51.59	\$57.11	\$37.47	\$264.09

The State of Connecticut receives on average more than \$68 million in new tax revenue in any given year as a result of the proposed improvements. Local revenues increase almost \$51 million in any given year on average as a result of the proposed improvements. The net present value of new tax revenue to the state over the ten-year period is more than \$480 million, while towns realize almost \$360 million in new tax revenue in net present value terms. Figure 4 shows the dynamics of the fiscal results as a result of the proposed improvements.

Figure 4



Economic and Fiscal Results of NOT Realizing Proposed Improvements (No-action)

If the proposed improvements do not materialize, the maintenance level of investment would be insufficient to forestall further deterioration of equipment. Business costs would increase by \$300 million on average in any given year between 2004 and 2014. These costs derive from the EPRI study and CL&P's forecast for increased outage minutes. In this case, there is no rate increase, no net new hiring, no new property taxes, and, no new construction; there will only be the current maintenance investment level. Tables 4 and 5 summarize the economic and fiscal results of the no-action case.

Table 4

CL&P: Economic Impact of Distribution Infrastructure Improvements (2004-2014)									
Impact Category	2005	2006	2008	2009	2011	2012	2014	Average	Net Present Value
Total Employment (FTE)	-1,191	-1,948	-3,649	-4,057	-4,579	-4,739	-4,964	-3,425	
Gross State Product (Million 2001\$)	-\$96.57	-\$165.59	-\$333.21	-\$385.98	-\$463.34	-\$491.63	-\$543.92	-\$338.02	(\$2,344.42)
Personal Income (Million 2001\$)	-\$55.73	-\$93.50	-\$186.91	-\$214.63	-\$261.77	-\$277.98	-\$301.90	-\$189.82	(\$1,318.15)

Table 5

CL&P: Fiscal Impact of Distribution Infrastructure Improvements (2004-2014)									
Impact Category	2005	2006	2008	2009	2011	2012	2014	Average	Net Present Value
State Revenues (Million 2001\$)	-\$16.18	-\$26.02	-\$48.15	-\$52.57	-\$59.45	-\$61.79	-\$65.43	-\$44.92	(\$316.59)
Local Revenues (Million 2001\$)	-\$3.71	-\$6.58	-\$14.15	-\$17.18	-\$22.55	-\$24.88	-\$28.92	-\$16.05	(\$109.50)
State Expenditures (Million 2001\$)	-\$0.96	-\$1.93	-\$4.75	-\$6.22	-\$8.83	-\$9.98	-\$11.97	-\$6.07	(\$40.66)
Local Expenditures (Million 2001\$)	-\$1.73	-\$3.47	-\$8.55	-\$11.18	-\$15.88	-\$17.96	-\$21.55	-\$10.91	(\$73.15)

Total employment decreases on average more 3,400 in any given year from 2004 through 2014. GSP declines on average more than \$338 million in any given in this period, while personal income declines an average of almost \$190 million in any given year. The net present values of GSP and personal income decline by more than \$2.3 billion and 1.3 billion respectively over the ten-year period. The fiscal picture is as gloomy with state tax declining an average \$45 million in any given year during 2004 through 2014 and local tax revenues declining by more than \$16 million on average in any given year. Figures 4 and 5 depict the time path of the economy's and the fiscal response to the no-action case. Increased production costs render Connecticut firms less competitive: their sales and employment decline and generate fewer tax dollars for the state and its municipalities.

Figure 4

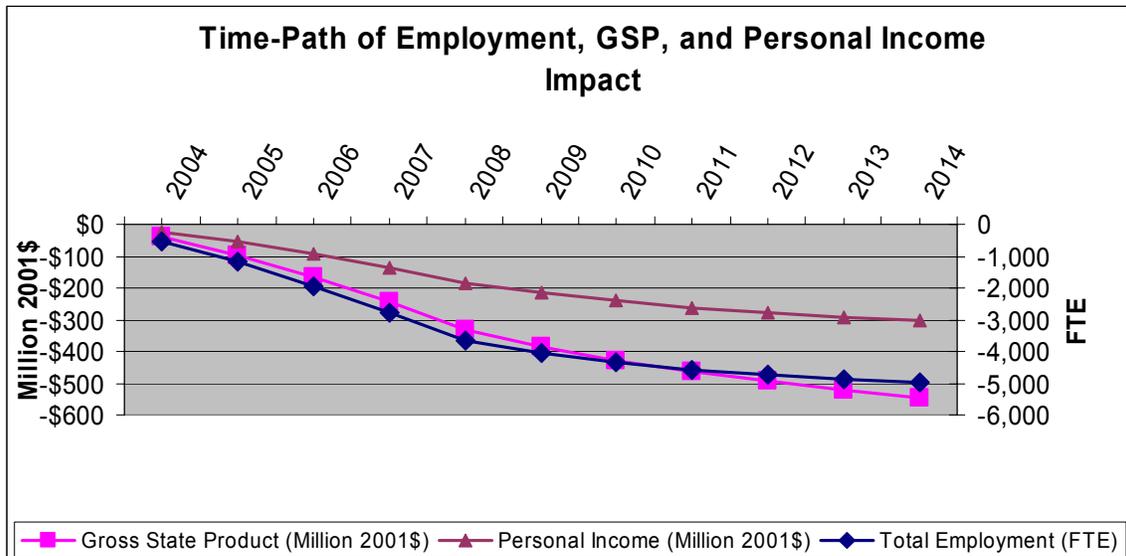
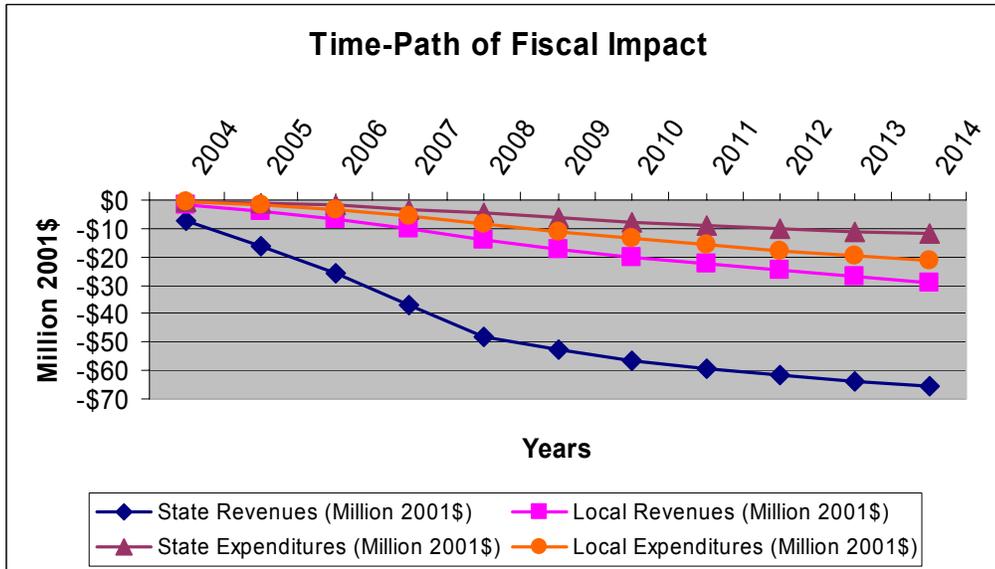


Figure 5



Conclusion

The benefit-cost ratio for GSP for the case in which the distribution infrastructure improvements materializes is 3.4 based on the ratio of the net present values of GSP increases and the rate increases over ten years. This means that for each CL&P dollar captured in the rate increase, almost \$3.40 returns to Connecticut in new value added. The benefit-cost ratio for personal income is 2.2 based on the ratios of the net present values of personal income increases and the rate increases over ten years. We conclude that substantial net economic gains flow from the proposed CL&P distribution infrastructure improvements.

Appendix: The REMI Model

The REMI Model

The Connecticut REMI model is a dynamic, multi-sector, regional model developed and maintained for the Connecticut Center for Economic Analysis by Regional Economic Models, Inc. of Amherst, Massachusetts. This model provides detail on all eight counties in the State of Connecticut and any combination of these counties. The REMI model includes all of the major inter-industry linkages among 466 private industries, aggregated into 49 major industrial sectors. With the addition of farming and three public sectors (state and local government, civilian federal government, and military), there are 53 sectors represented in the model for the eight counties.

The REMI model is based on a nationwide *input-output* (I/O) model that the U.S. Department of Commerce (DOC) developed and continues to maintain. Modern input-output models are largely the result of groundbreaking research by Nobel laureate Wassily Leontief. Such models focus on the inter-relationships between industries and provide information about how changes in specific variables—whether economic variable such as employment or prices in a certain industry or other variables like population affect factor markets, intermediate goods production, and final goods production and consumption.

The REMI Connecticut model takes the U.S. I/O “table” results and scales them according to traditional regional relationships and current conditions, allowing the relationships to adapt at reasonable rates to changing conditions. Listed below are some salient structural characteristics of the REMI model:

- REMI determines consumption on an industry-by-industry basis, and models real disposable income in Keynesian fashion, i.e., with prices fixed in the short run and GDP (Gross Domestic Product) determined solely by aggregate demand.
- The demand for labor, capital, fuel, and intermediate inputs per unit of output depends on relative prices of inputs. Changes in relative prices cause producers to substitute cheaper inputs for relatively more expensive inputs.

- Supply and demand for labor in a sector determine the wage level, and these characteristics are factored by regional differences. The supply of labor depends on the size of the population and the size of the workforce.
- Migration—that affects population size—depends on real after-tax wages as well as employment opportunities and amenity value in a region relative to other areas.
- Wages and other measures of prices and productivity determine the cost of doing business. Changes in the cost of doing business will affect profits and/or prices in a given industry. When the change in the cost of doing business is specific to a region, the share of local and U.S. market supplied by local firms will also be affected. Market share and demand determine local output.
- “Imports” and “exports between states are related to relative prices and relative production costs.
- Property income depends only on population and its distribution adjusted for traditional regional differences, *not* on market conditions or building rates relative to business activity.
- Estimates of transfer payments depend on unemployment details of the previous period, and total government expenditures are proportional to population size.
- Federal military and civilian employment is exogenous and maintained at a *fixed* share of the corresponding total U.S. values, unless specifically altered in the analysis.

Because the variables in the REMI model are all related, a change in any one variable affects many others. For example, if wages in a certain sector rise, the relative prices of inputs change and may cause the producer to substitute capital for labor. This changes demand for inputs, which affects employment, wages, and other variables in those industries. Changes in employment and wages affect migration and the population level that in turn affect other employment variables. Such chain-reactions continue in time across all sectors in the model. Depending on the analysis performed, the nature of the chain of events cascading through the model economy can be as informative for the policymaker as the final aggregate results. Because REMI generates extensive sectoral detail, it is possible for experienced economists in this field to discern the dominant causal linkages involved in the results.