Measuring the Economic Impact of the NEEWS Project in Connecticut and Western Massachusetts

Final Draft

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For

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Executive Summary

This study shows the economic impact of proposed improvements to the electricity transmission system in Connecticut and Western Massachusetts for the New England East-West Solution (NEEWS) transmission project. Northeast Utilities (NU), herein referring to two of its subsidiaries Connecticut Light and Power (CL&P) and Western Massachusetts Electric Company (WMECO), retained Regional Economic Models, Inc. (REMI) to conduct the analysis. The project[1] includes four transmission lines and related projects in Connecticut, Massachusetts and Rhode Island. The total cost of the four lines is $2 billion with $1.49 billion occurring in the NU Connecticut and Western Massachusetts services areas. The project is considered to be of regional benefit so the costs are expected to be allocated across all New England based on each region's share of New England's electric load. This analysis uses the $1.49 billion construction cost to measure the economic impact of NEEWS expenditures in the NU service area. Connecticut and Western Massachusetts energy demand is roughly one-third the New England load, so the retail rate impact in this analysis is roughly one-third of the total cost ($2 billion).

We evaluated the impacts of direct capital expenditures, electricity price increases, and business and household benefits resulting from the savings incurred from an estimated reduction in Connecticut congestion and related charge fees (at six different levels of savings) and from the savings in Reliability-Must Run (RMR) fees in Western Massachusetts. The analysis was completed using the REMI Policy Insight® model developed specifically for the state of Connecticut and Western Massachusetts regions.

The REMI Policy Insight 70-sector model of Connecticut and Western Massachusetts (a two region model) is a complete representation of the macroeconomic structure of the region. By entering direct changes to business costs, expenditures, and rates for each region, the model forecasts the total impact on economic activity.

NU will request rate increases in its CL&P and WMECO service territories in order to fund improvements in the reliability of the electrical transmission system that will ultimately lead to congestion charge and RMR fee savings for electricity customers. While electricity rate increases reduce business competitiveness and raise consumer prices, the investments also stimulate business activity. The revenue collected from this rate increases will enable NU to finance its direct capital expenditures in infrastructure, which will lead to local benefits for employees and firms that are engaged in construction, as well as intermediate suppliers and service providers. The overriding purpose of the investments, improved electricity reliability and consequently a reduction in congestion charge and RMR fees, increases economic activity through enhanced business competitiveness. The improved competitiveness of affected firms provides a further stimulus to the economy through higher wage disbursements to their employees and increased business with their suppliers and customers. The net impact is more economic growth, jobs, and income for residents and higher tax revenues for the states of Connecticut and Massachusetts.

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[1] The four projects are the Greater Springfield Reliability Project (NU project), the Interstate Reliability Project (NU and National Grid project), the Central Connecticut Reliability Project (NU project), and the Rhode Island Reliability Project (National Grid project).

The congestion scenarios used in this study were developed to provide a range of estimates about the potential impact of the NEEWS project on energy costs, e.g. congestion savings and other related cost savings (Table 1). While preliminary estimates show that anticipated energy savings are likely to be in the $100 million per year range for Connecticut and about $25 million for Western Massachusetts, NU has hired an independent consultant to calculate the actual projected energy and related cost savings from NEEWS. This study is being conducted independent of the REMI analysis.

Table 1: CT Congestion and Related Savings and Western MA RMR and Related Savings Scenarios

Scenario / Alternative Forecast	CT Congestion and Related Savings	Western MA RMR and Related Savings
1 (First Alternative Forecast)	$0	$25 Million
2 (Second Alternative Forecast)	$50 Million	$25 Million
3 (Third Alternative Forecast)	$100 Million	$25 Million
4 (Fourth Alternative Forecast)	$150 Million	$25 Million
5 (Fifth Alternative Forecast)	$200 Million	$25 Million
6 (Sixth Alternative Forecast)	$250 Million	$25 Million

Source: NU (2007)

While the rate increases used to finance the NEEWS project initially dampen economic activity, this study shows overall net economic benefits due to the positive effect of construction expenditures and improved business competitiveness from the savings in congestion and RMR fees. Positive benefits to customers are realized under the scenarios that include the greatest Connecticut congestion charge savings because the actual electric bill paid by the customer declines.

The majority of the economy will experience strong growth throughout the analysis period for scenarios three, four, five, and six, in which the Connecticut congestion charge savings equal or exceed $100 million. The strong growth in employment results initially in the form of construction jobs from the capital improvements made to the system. As the capital improvements are completed, the congestion savings begin to be realized over time, provide cost savings to households and businesses, and also improve productivity for businesses, resulting in long-term job growth as well.

Table 2: Annual Average and Cumulative Impacts (2009 – 2023), State of Connecticut and Western Massachusetts Combined, July 2008 $s

Scenario	Connecticut Savings / Massachusetts Savings ($M)	Average Annual Employment (Jobs)	Average Gross State Product ($M)	Cumulative Gross State Product ($M)	Average Disposable Personal Income ($M)	Cumulative Disposable Personal Income ($M)
1	$0 / $25	283	11.6	174	-15.7	-236.0
2	$50 / $25	438	33.9	508	9.9	149.2
3	$100 / $25	594	56.2	843	35.8	536.3
4	$150 / $25	750	78.7	1,180	61.7	925.6
5	$200 / $25	907	101.2	1,518	87.6	1,314.2
6	$250 / $25	1,064	123.7	1,856	113.6	1,703.7

Table 3 shows that, at its peak, the NEEWS projects will result in 3,185 new jobs in the Connecticut (1,717) and western Massachusetts (1,469) areas. Depending on the level of congestion and/or RMR and related savings achieved, construction of the NEEWS projects is expected to generate an average of 283 jobs to 1,064 new jobs per year from 2009 through 2023.

Table 3: Employment Change (Annual 2009-2013; Average 2009-2023), By Region

State of Connecticut and Western Massachusetts Combined

Scenario	Connecticut Savings/ Massachusetts Savings Savings ($M)	Construction Phase Employment 2009	2010	2011	2012	2013	Average Annual Employment 2009-2023
1	$0 / $25	2,407	3,185	2,355	926	126	283
2	$50 / $25	2,407	3,185	2,355	926	287	438
3	$100 / $25	2,407	3,185	2,355	926	448	594
4	$150 / $25	2,407	3,185	2,355	926	610	750
5	$200 / $25	2,407	3,185	2,355	926	772	907
6	$250 / $25	2,407	3,185	2,355	926	935	1,064

State of Connecticut

Scenario	Connecticut Savings / Massachusetts Savings Savings ($M)	Construction Phase Employment 2009	2010	2011	2012	2013	Average Annual Employment 2009-2023
1	$0 / $25	1,308	1,717	1,264	498	-115	-7
2	$50 / $25	1,308	1,717	1,264	498	42	146
3	$100 / $25	1,308	1,717	1,264	498	199	299
4	$150 / $25	1,308	1,717	1,264	498	357	452
5	$200 / $25	1,308	1,717	1,264	498	516	606
6	$250 / $25	1,308	1,717	1,264	498	674	760

Western Massachusetts

Scenario	Connecticut Savings / Massachusetts Savings Savings ($M)	Construction Phase Employment 2009	2010	2011	2012	2013	Average Annual Employment 2009-2023
1	$0 / $25	1,099	1,469	1,091	428	241	290
2	$50 / $25	1,099	1,469	1,091	428	245	292
3	$100 / $25	1,099	1,469	1,091	428	249	295
4	$150 / $25	1,099	1,469	1,091	428	252	298
5	$200 / $25	1,099	1,469	1,091	428	256	301
6	$250 / $25	1,099	1,469	1,091	428	260	304

It is important to note that this analysis did not attempt to quantify the benefits of improving overall transmission reliability, e.g. the savings from avoiding a blackout. As was found from the blackout of 2003, a blackout can cost the economy billions of dollars. Similarly, the analysis does not reflect other related savings to be produced by the NEEWS project, e.g. environmental impact savings or enhanced access to renewable energy resources (Alternative Compliance Payments). Also, the direct and spillover effects of the NEEWS projects in Rhode Island and eastern Massachusetts are not included.

Methodology / Scenario Description

For this analysis, NU provided REMI with data for direct capital expenditures, electricity rate increases by customer type, and six potential Connecticut congestion charge savings estimates and the Western Massachusetts RMR fee savings. Six simulations were completed, representing the six congestion savings scenarios. Each simulation has two overall components: one regards changes in the price of electricity and the other regards the construction phase. Construction amounts are the same in all six simulations.

To help pay for the project, electricity rates will increase for consumers in both Connecticut and Western Massachusetts. Consequently, with increasing capacity, consumers in Connecticut will experience savings from a reduction in congestion fees, which are incurred when power is bought and routed over power lines that are overloaded. Since a precise estimate has not yet been developed, for this study the savings are modeled under six simulations, using $50 million increments, from $0 to $250 million.

For the purposes of this study, it was estimated that customers in Massachusetts will see a fixed $25 million savings from a decrease in RMR fees, in all six scenarios. "RMR agreements guarantee payments to generators that are needed to ensure reliability. To obtain an agreement, a generator must receive verification from ISO-NE [Independent System Operator – New England] that it's needed for reliability and must demonstrate that it is unable to cover its operating costs with revenue from other sources, including day-ahead and real-time energy markets and bilateral contracts. RMR agreements are intended for use only as a last resort to ensure that a unit remains in operation for reliability."[2]

To summarize, there are six simulations representing the six congestion savings scenarios and each have the same fixed construction expenditure amount and fixed Western Massachusetts customer RMR savings amount. The only difference among the six simulations is the estimated congestion savings to Connecticut customers.

Table 4 shows the Connecticut congestion charge savings and Western Massachusetts RMR fees savings for electricity customers for each scenario / alternative forecast.

Table 4: CT Congestion and Related Savings and Western MA RMR and Related Savings Scenarios

Scenario / Alternative Forecast	CT Congestion and Related Savings	Western MA RMR and Related Savings
1 (First Alternative Forecast)	$0	$25 Million
2 (Second Alternative Forecast)	$50 Million	$25 Million
3 (Third Alternative Forecast)	$100 Million	$25 Million
4 (Fourth Alternative Forecast)	$150 Million	$25 Million
5 (Fifth Alternative Forecast)	$200 Million	$25 Million
6 (Sixth Alternative Forecast)	$250 Million	$25 Million

Source: NU (2007)

[2] "SUEZ Opposes New RMR Fees in SEMA", SUEZ Energy Resources NA, 2006.

It is important to note that this analysis did not attempt to quantify the benefits of improving overall transmission reliability, e.g., the savings from avoiding a blackout. The NEEWS project will lead to higher quality transmission and delivery of electricity which in and of itself will be beneficial to local consumers and businesses. Furthermore, this analysis does not include environmental impact savings and the benefits of enhanced access to renewable energy resources, which would reduce alternative compliance payments. Through the above, the NEEWS project will have greater benefits than those already outlined in this report.

Major Findings

The analysis period for this project is 2009-2023. By providing an outlook to 2023 we can assess both short-term construction impacts and long-term industry and household impacts. Throughout the study period the cost of doing business and the cost of living in Connecticut and Western Massachusetts are directly affected and the analysis results allow us to understand how businesses and households respond to the NU rate increase and the ensuing Connecticut congestion charge savings and Massachusetts RMR fee savings.

The first alternative forecast captures a transmission system that provides no congestion savings to Connecticut electricity customers and a $25 million savings to Western Massachusetts customers. The capital expenditures, consisting of construction spending, and the rate increase to fund the capital improvements are included in this scenario, as they are in all the other scenarios. Due to the direct investments and the ensuing rate increase, it is estimated that on average 334 net new jobs will be created annually in Connecticut and Western Massachusetts. All job growth under this scenario takes place during the capital improvement phase, primarily in the construction industry. In the post capital improvement phase, after 2012, there is a loss of jobs resulting from the increase in fees with no congestion charge saving to Connecticut customers. By 2023, the cumulative change to Gross Regional Product (GRP) in Connecticut and Western Massachusetts will be $174 million, again a result of the construction taking place during the capital improvement phase. By 2023 the after-tax disposable personal income will decline by $236 million. In this case, the disposable income generated during the construction phase is not enough to outweigh the loss in income from job losses during the post construction phase.

The second alternative forecast captures a transmission system that provides $50 million in savings to Connecticut electricity customers and a $25 million savings to Western Massachusetts customers. Due to the direct investments and congestion charge and RMR fees savings, it is estimated that on average 485 net new jobs will be created annually in Connecticut and Western Massachusetts. Again, all job growth under this scenario also takes place during the capital improvement phase, primarily in the construction industry. However, the loss of jobs during the post construction phase is far less than what was experienced under the $0 Connecticut congestion savings scenario. By 2023, the cumulative change to GRP in Connecticut and Western Massachusetts will be $508 million, and after-tax disposable personal income will grow by $149.2 million.

For our third alternative forecast we designed a simulation that captures a transmission system that provides $100 million in congestion charge savings to Connecticut customers and $25 million in RMR fees savings to Massachusetts customers. Due to the direct investments and savings by consumers, it is estimated that on average 635 net new jobs will be created annually in Connecticut and Western Massachusetts. The new jobs under this scenario are primarily in construction during the capital improvement phase, as there continues to be a very slight loss of jobs overall during the post construction phase. However, under this scenario (as opposed to the two above) there are now some industries that do gain jobs in the post construction period, including manufacturing, wholesale trade, professional services, and information. By 2023, the cumulative change to GRP in Connecticut and Western Massachusetts will be $843.2 million, and after-tax disposable personal income will grow by $536.3 million.

For our fourth alternative forecast we designed a simulation that captures a transmission system that provides $150 million in congestion charge savings to Connecticut customers and $25 million in RMR fees savings to Massachusetts customers. Due to the direct investments and savings by consumers, it is estimated that on average 787 net new jobs will be created annually in Connecticut and Western Massachusetts. In addition to the construction jobs during the capital improvement phase, this scenario shows long-term job creation in other industries as well. The health care, retail trade, and professional services sectors show the strongest long-term growth. By 2023, under this scenario, the cumulative change to GRP in Connecticut and Western Massachusetts will be $1.18 billion, and after-tax disposable personal income will grow by $925.7 million.

For our fifth alternative forecast we designed a simulation that captures a transmission system that provides $200 million in congestion charge savings to Connecticut customers and $25 million in RMR fees savings to Massachusetts customers. Due to the direct investments and savings by consumers, it is estimated that on average 939 net new jobs will be created annually in Connecticut and Western Massachusetts. In addition to the construction jobs during the capital improvement phase, this scenario shows long-term job creation in other industries as well, primarily in health care, retail trade, professional services, and food services. By 2023, the cumulative change to GRP in Connecticut and Western Massachusetts, under this scenario, is $1.52 billion, and after-tax disposable personal income will grow by $1.31 billion.

For our sixth alternative forecast we designed a simulation that captures a transmission system that provides $250 million in congestion charge savings to Connecticut customers and $25 million in RMR fees savings to Massachusetts customers. Due to the direct investments and savings by consumers it is estimated that on average 1,091 net new jobs will be created annually in Connecticut and Western Massachusetts. In addition to the construction jobs during the capital improvement phase, this scenario shows the strongest long-term job growth in the health care, retail trade, professional services, and food services industries. Additionally, moderate job growth is also experienced in other services, manufacturing, and finance and insurance. By 2023, the cumulative change to GRP in Connecticut and Western Massachusetts, under this scenario, is $1.86 billion, and after-tax disposable personal income will grow by $1.7 billion.

Table 5 summarizes the economic growth in the State of Connecticut and Western Massachusetts regions due to NU investments, proposed rate increase, and business benefits. It should be noted that the employment and disposable personal income gains flow to the residents of Connecticut and Western Massachusetts.

Table 5: Average Annual Economic Impact (2009-2023), State of Connecticut and Western Massachusetts, July 2008 $s

Scenario	Connecticut Congestion Savings ($M)	Massachusetts RMR Savings ($M)	Employment (Jobs)	Gross State Product ($M)	Disposable Personal Income ($M)	Disposable Personal Income Per Capita ($)
1	0	25	283	11.6	-15.7	-3
2	50	25	438	33.9	9.9	0
3	100	25	594	56.2	35.8	3
4	150	25	750	78.7	61.7	6
5	200	25	907	101.2	87.6	9
6	250	25	1,064	123.7	113.6	12

Investments made in the NU transmission system will stimulate net positive economic growth throughout the Connecticut and Western Massachusetts region. Under the first scenario, in which there is no Connecticut congestion charge savings, the long-term impact (post capital improvements) on customers is negative. The $50 million and $100 million congestion savings scenarios also produce short-term gains from capital investments but as customer rates increase, the gains become negated in the long term. The long-term positive impacts on customers begin to be realized when over $100 million in Connecticut congestion charge savings are initiated. The economic impact on the region continues to grow as the congestion charge savings increase.

To summarize, the majority of the economy will experience strong growth throughout the analysis period for scenarios four, five, and six, in which the Connecticut congestion charge savings exceed $100 million. The strong growth in employment results initially in the form of construction jobs from the capital improvements made to the system. As the capital improvements are completed, the congestion savings begin to be realized over time, provide cost savings to households and businesses, and also improve productivity for businesses, resulting in long-term job growth as well.

To assist in understanding the net economic impacts of NU investment in the NEEWS project, our analysis can be observed in a multi-phase perspective. Table 6 reveals the different employment impacts of the NU investment detailed by project phase for each Connecticut Congestion charge savings scenario. As stated earlier, the Western Massachusetts RMR fee savings are estimated to be the same for each scenario ($25 million). It should be noted that, the rate increase phase actually runs from 2013 to 2023 and the household and business benefits phase actually runs from 2014 to 2023. Since the overlap in time periods makes it difficult to isolate the true impacts of each phase, to show a better picture of the true impacts, the time periods are separated (as shown in the chart below), since the benefits get further realized over time. It should also be noted that, although construction cost and capital improvements are the same for all scenarios, the final year of the capital investment period (2013) over laps with the first year of rate increases and savings in congestion charge fees and RMR fees. Since the congestion charge fees vary for each scenario, this causes the average employment during the construction phase to also vary slightly among scenarios. In the year 2013 the actual construction period has ended, however, there is still spending by NU on real estate easements, local engineering consultants and services, taxes on construction labor and materials, and the increase in employment at NU due to the NEEWS project; this is categorized as additional capital improvement spending.

Table 6: Average Annual Employment Impacts by Phase, State of Connecticut and Western Massachusetts, by CT Congestion Charge Savings Scenarios

Scenario	Direct Capital Investment Phase (2009-2013)	Short-Term Electricity Rate Increase Phase (2014-2018)	Long-Term Household & Business Benefits Phase (2019-2023)	NET (2009-2023)
1	1,800	-479	-472	283
2	1,832	-271	-247	438
3	1,864	-61	-22	594
4	1,897	149	206	750
5	1,929	360	433	907
6	1,962	571	660	1,064

By providing the businesses in Connecticut and Western Massachusetts with improved power quality and a subsequent electricity cost savings from lower congestion and RMR fees, NU enables these firms to operate more efficiently. As the market shares of the positively impacted sectors expand, so does demand for additional employment. In addition, the average annual compensation for most sectors increases, thus, an increase in disposable personal income leads to additional consumption in the Connecticut and Massachusetts economies. In addition, the electricity cost savings to households in the Connecticut and Western Massachusetts regions lead to further increases in consumption. Consequently, demand for consumer goods increases, leading to further job creation (particularly in the retail trade and service sectors). Residents will also benefit from improved employment opportunities and slightly higher incomes.

1. Approach, Data Inputs, & Business Benefits

In designing these simulations, both benefits and costs of the NU investment in the NEEWS project are analyzed. The benefits include the capital investments in the system and the ensuing savings in the congestion charges (Connecticut customers) and RMR fees (Western Massachusetts customers). The costs include the electricity rate increase used to fund the project. By analyzing both benefits and costs, REMI is able to deliver complete results, capturing the net economic impact of this project. Also, for transparency purposes, the assumptions and modeling steps are detailed in the section below.

1-1 Assumptions

Contained below is a description of the modeling assumptions developed for this study.

- Direct capital expenditures made to the NU transmission system are modeled as an increase in construction employment, an increase in demand for equipment (investment spending in producers durable equipment), and an increase in demand for local materials (intermediate demand in all impacted industry sectors).
- Other expenditures made by NU during the capital improvement phase, are modeled as industry sales, government spending, and industry employment in utilities, which represent per diem spending by temporary construction workers, real estate and professional service spending, taxes paid, and hiring by NU.
- Electricity rate increases occur in the industrial, commercial, household, and government customer categories. In addition, electricity rate increases were also modeled for an individual industry: rail transportation in Connecticut.
- Industrial, commercial, and individual industry (rail transportation) rate increases were modeled as an increase in the Cost of Electricity.
- Residential rate increases were modeled as an increase in consumer price for electricity, which in the model is under the household operations category.
- Government rate increases, which specifically represent an increase in the cost of street lighting, were modeled as local government spending.
- The dollar value used to calculate the local impacts of NEEWS are based on the Connecticut and Western Massachusetts investment of $1.49 billion while the total cost of NEEWS ($2 billion) was used to calculate the electricity rate impacts. Spillover effects from Rhode Island are not included in this analysis.

1-2 Simulation Variables

For this study, a number of economic policy variables were directly affected. Within the REMI Policy Insight model, the user has various policy “levers” that can be directly changed in either a positive or negative direction. For more information on the structure of the REMI Policy Insight model please reference the model description in the Appendix. Listed below is a description for each of the policy variables used in the various simulations.

Industry Employment (Construction Workers)

REMI Policy Insight is a complex economic forecasting tool that allows the user to enter situation-specific variable changes. REMI modeled significant increases in employment in the construction sector through the Industry Employment variable. The application of the Industry Employment variable for activity associated with the NU investment allows for an increase in employment without displacing current regional market activity. The decision to model without local competition for labor and market shares was made because the type of investment made is highly specialized. Compensation levels for the construction workers, provided by NU, are also included. In addition, the profits generated by non-local workers were removed from the region.

Industry Sales (Accommodations and Food Services and Drinking Places)

This variable reflects the per diem spending of the temporary workers during the construction phase. Construction related workers drawn to the region to work on the capital improvement project are awarded per diem expenses for hotel and meals costs, which are spent locally.

Investment Spending (Producer's Durable Equipment)

NU plans to make a substantial investment in its electric transmission system for the NEEWS project. For these non-labor expenditures, which include local equipment required by the construction workers, we applied the Producer's Durable Equipment variable to capture such investments.

Intermediate Demand (All Impacted Industry Sectors)

The intermediate demand variables reflect demand for local materials needed by the construction workers. The levels of demand are derived using total materials spending and the Input/Output matrix for construction and the impacted industry sectors throughout the local economy.

Industry Sales / Exogenous Production (Real Estate and Prof. & Tech. Serv.)

During the capital improvement phase, NU will incur costs to obtain easements and to hire local engineering consultants to provide services for the NEWWS project. This variable models these costs as industry sales in the local economy on real estate (for the purchase of easements) and professional and technical services (for the engineering consultants).

Government Spending (State and Local)

During the capital improvement phase, state and local governments will collect taxes on construction labor and materials. This is modeled as government spending, as these taxes are collected and, in turn, spent at the state and local level.

Government Spending (Local)

An additional government spending variable is also used, local government spending. Local government spending is applied to model the spending by municipal governments on street lighting. This is modeled as both a cost and a savings, depending on the Connecticut Congestion Charge level. In the case of this variable, positive numbers indicate savings. As the cost of providing street lighting decreases, money is freed up for other uses, which is shown by increasing government spending.

Industry Employment (Utilities)

During the capital investment phase, NU will be hiring workers to service the NEEWS project. These workers will perform functions pertaining to engineering, project management, and siting and permitting. This is modeled as industry employment in the utilities sector.

Cost of Electricity (Commercial, Industrial)

The proposed rate case will have the effect of increasing the per unit (kilowatt/hr) cost of electricity for NU's commercial and industrial customers. This change is modeled as a constant change above the regional economic control forecast in order to account for the long-term impact. This variable also encompasses the levels of congestion charge savings as shown by the scenario / simulation name, varying from $0 to $250 million for Connecticut customers. For Massachusetts customers the savings are flat, reflecting the estimated $25 million of RMR fee (backup generation) savings.

Cost of Electricity for Individual Industry (Rail Transportation)

The proposed rate case will also have an effect on the Rail Transportation industry in Connecticut, since the state maintains an extensive electrified rail transportation system. This variable was only used for the Connecticut simulation, as Western Massachusetts railroads are not electrified and thus would not be directly impacted by a rate increase.

Consumer Price (Household Operations)

The proposed rate case also includes an increase in the price of electricity for residential customers. The consumer price (household operations) variable captures this price increase and effectively increases the cost of living in Connecticut and Western Massachusetts. As with the commercial and industrial customers, this variable also encompasses the levels of congestion charge savings and RMR fee savings.

1-3 Model Inputs

Summarized in Tables 7 – 10 are the inputs to the REMI Policy Insight model for the direct capital expenditures and electricity rate increases less the Connecticut congestion charge savings and the Western Massachusetts RMR fees savings.

Direct and Other Capital Expenditures[3]

Table 7: NU Direct Capital Expenditures (2009-2012)

Connecticut	2009	2010	2011	2012
Industry Employment	214	306	214	31
Compensation	$54,454,051	$77,791,502	$54,454,051	$ 7,779,150
Equipment (Investment Spending)	$ 2,334,363	$ 3,334,804	$ 2,334,363	$ 333,480
Local Materials (Intermediate Demand)	$ -	$14,790,223	$ 7,395,111	$ 7,395,111
Western Massachusetts	**2009**	**2010**	**2011**	**2012**
Industry Employment	154	221	154	22
Compensation	$39,012,430	$55,732,043	$39,012,430	$ 5,573,204
Equipment (Investment Spending)	$ 1,680,555	$ 2,400,793	$ 1,680,555	$ 240,079
Local Materials (Intermediate Demand)	$ -	$11,478,348	$ 5,739,174	$ 5,739,174

Table 8: NU Other Capital Expenditures (2009-2013)

Connecticut	2009	2010	2011	2012	2013
Industry Sales (per diem Spending)	$15,737,380	$18,335,171	$15,737,380	$10,541,799	$9,675,869
Industry Sales (Real Est. & Prof. Ser.)	$ 7,715,680	$10,957,600	$ 7,715,680	$ 1,231,840	$ 151,200
Government Spending (Taxes)	$ 6,648,732	$ 2,955,070	$ 2,216,244	$ 2,216,244	$ 738,709
Industry Employment (Utilities)	65	63	60	58	56
Western Massachusetts	**2009**	**2010**	**2011**	**2012**	**2013**
Industry Sales (per diem Spending)	$11,539,378	$13,444,199	$11,539,378	$ 7,729,736	$7,094,796
Industry Sales (Real Est. & Prof. Ser.)	$10,749,566	$14,786,246	$10,749,566	$ 2,676,206	$1,330,646
Government Spending (Taxes)	$ 3,311,541	$ 1,471,835	$ 1,103,847	$ 1,103,847	$ 367,930
Industry Employment (Utilities)	66	64	61	59	57

[3] Inputs for the REMI model were directly derived from data provided from NU. The data included expenditures on both local and out-of-region expenditures. This analysis only includes expenditures within the region as those monies spent outside the region do not impact the local region's economy.

Electricity Rate Increase / Savings CT

Table 9: NU Estimated Electricity Rate Increase Less CT Congestion Charge Savings & Western MA RMR Fee Savings, 2013-2023, Nominal '000's $

Connecticut		2013	2014	2015	2016	2017	2018
CT $0 Congestion Charge Savings							
Consumer Price	Household Operation	60,025	55,032	54,244	53,642	52,969	52,608
Cost of Electricity	Commercial	52,963	48,522	47,769	46,987	46,368	45,621
Cost of Electricity	Industrial	12,469	11,163	10,710	10,275	9,919	9,530
CT 50 M Congestion Charge Savings							
Consumer Price	Household Operation	36,400	31,407	30,619	30,017	29,344	28,983
Cost of Electricity	Commercial	32,118	27,677	26,923	26,142	25,522	24,776
Cost of Electricity	Industrial	7,561	6,256	5,802	5,368	5,012	4,623
CT 100 M Congestion Charge Savings							
Consumer Price	Household Operation	12,776	7,782	6,994	6,393	5,719	5,358
Cost of Electricity	Commercial	11,272	6,832	6,078	5,296	4,677	3,930
Cost of Electricity	Industrial	2,654	1,348	895	460	104	-285
CT 150 M Congestion Charge Savings							
Consumer Price	Household Operation	-10,849	-15,842	-16,631	-17,232	-17,906	-18,267
Cost of Electricity	Commercial	-9,573	-14,014	-14,767	-15,549	-16,168	-16,915
Cost of Electricity	Industrial	-2,254	-3,560	-4,013	-4,448	-4,804	-5,192
CT 200 M Congestion Charge Savings							
Consumer Price	Household Operation	-34,474	-39,467	-40,256	-40,857	-41,531	-41,892
Cost of Electricity	Commercial	-30,418	-34,859	-35,613	-36,395	-37,014	-37,760
Cost of Electricity	Industrial	-7,161	-8,467	-8,921	-9,355	-9,711	-10,100
CT 250M Congestion Charge Savings							
Consumer Price	Household Operation	-58,099	-63,092	-63,881	-64,482	-65,156	-65,517
Cost of Electricity	Commercial	-51,264	-55,705	-56,458	-57,240	-57,859	-58,606
Cost of Electricity	Industrial	-12,069	-13,375	-13,828	-14,263	-14,619	-15,008
Western MA 25 M RMR Savings		**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Consumer Price	Household Operation	1,053	-106	-289	-428	-584	-668
Cost of Electricity	Commercial	781	-85	-232	-385	-505	-651
Cost of Electricity	Industrial	204	-79	-177	-271	-348	-432

Connecticut		2019	2020	2021	2022	2023
CT $0 Congestion Charge Savings						
Consumer Price	Household Operation	52,319	52,090	51,896	51,714	51,538
Cost of Electricity	Commercial	44,939	44,316	43,732	43,163	42,608
Cost of Electricity	Industrial	9,155	8,804	8,472	8,155	7,850
CT 50 M Congestion Charge Savings						
Consumer Price	Household Operation	28,694	28,465	28,271	28,089	27,913
Cost of Electricity	Commercial	24,094	23,471	22,886	22,318	21,762
Cost of Electricity	Industrial	4,247	3,896	3,565	3,247	2,942
CT 100 M Congestion Charge Savings						
Consumer Price	Household Operation	5,069	4,840	4,646	4,464	4,288
Cost of Electricity	Commercial	3,248	2,626	2,041	1,473	917
Cost of Electricity	Industrial	-660	-1,011	-1,343	-1,661	-1,965
CT 150 M Congestion Charge Savings						
Consumer Price	Household Operation	-18,555	-18,785	-18,978	-19,161	-19,337
Cost of Electricity	Commercial	-17,597	-18,220	-18,804	-19,373	-19,928
Cost of Electricity	Industrial	-5,568	-5,919	-6,250	-6,568	-6,873
CT 200 M Congestion Charge Savings						
Consumer Price	Household Operation	-42,180	-42,410	-42,603	-42,786	-42,961
Cost of Electricity	Commercial	-38,442	-39,065	-39,650	-40,218	-40,774
Cost of Electricity	Industrial	-10,475	-10,826	-11,158	-11,476	-11,780
CT 250M Congestion Charge Savings						
Consumer Price	Household Operation	-65,805	-66,035	-66,228	-66,411	-66,586
Cost of Electricity	Commercial	-59,288	-59,911	-60,495	-61,064	-61,619
Cost of Electricity	Industrial	-15,383	-15,734	-16,066	-16,383	-16,688
Western MA 25 M RMR Savings		**2019**	**2020**	**2021**	**2022**	**2023**
Consumer Price	Household Operation	-735	-788	-833	-875	-916
Cost of Electricity	Commercial	-784	-906	-1,020	-1,130	-1,239
Cost of Electricity	Industrial	-513	-589	-660	-729	-795

Table 10: Municipal Government Spending on Street Lighting and Savings to Electrified Railroads in Connecticut, 2013-2023, Nominal '000'$s[4]

Connecticut		**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
CT $0 Congestion Charge Savings							
Government Spending	Local	-540	-483	-465	-446	-430	-413
Cost of Electricity for Individual Industry	Rail transportation	1,041	957	945	932	925	913
CT 50 M Congestion Charge Savings							
Government Spending	Local	-327	-274	-260	-244	-233	-219
Cost of Electricity for Individual Industry	Rail transportation	631	543	528	511	500	485
CT 100 M Congestion Charge Savings							
Government Spending	Local	-115	-66	-55	-43	-35	-25
Cost of Electricity for Individual Industry	Rail transportation	222	130	111	90	75	56
CT 150 M Congestion Charge Savings							
Government Spending	Local	98	143	150	158	162	168
Cost of Electricity for Individual Industry	Rail transportation	-188	-283	-306	-330	-349	-372
CT 200 M Congestion Charge Savings							
Government Spending	Local	310	352	355	359	360	362
Cost of Electricity for Individual Industry	Rail transportation	-598	-697	-723	-751	-774	-801
CT 250M Congestion Charge Savings							
Government Spending	Local	522	561	560	561	557	555
Cost of Electricity for Individual Industry	Rail transportation	-1,008	-1,110	-1,140	-1,172	-1,198	-1,229
Western MA 25 M RMR Savings		**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Government Spending	Local	-7	2	5	8	11	13

Connecticut		**2019**	**2020**	**2021**	**2022**	**2023**
CT $0 Congestion Charge Savings						
Government Spending	Local	-396	-381	-366	-353	-339
Cost of Electricity for Individual Industry	Rail transportation	903	894	885	877	868
CT 50 M Congestion Charge Savings						
Government Spending	Local	-207	-195	-184	-174	-165
Cost of Electricity for Individual Industry	Rail transportation	471	458	445	433	421
CT 100 M Congestion Charge Savings						
Government Spending	Local	-17	-9	-2	4	10
Cost of Electricity for Individual Industry	Rail transportation	38	21	5	-11	-26
CT 150 M Congestion Charge Savings						
Government Spending	Local	173	177	180	183	185
Cost of Electricity for Individual Industry	Rail transportation	-394	-415	-435	-454	-474
CT 200 M Congestion Charge Savings						
Government Spending	Local	363	363	362	361	360
Cost of Electricity for Individual Industry	Rail transportation	-826	-851	-875	-898	-921
CT 250M Congestion Charge Savings						
Government Spending	Local	552	549	544	540	535
Cost of Electricity for Individual Industry	Rail transportation	-1,259	-1,287	-1,315	-1,341	-1,368
Western MA 25 M RMR Savings		**2019**	**2020**	**2021**	**2022**	**2023**
Government Spending	Local	16	18	21	23	25

[4] See Government Spending (Local) on page 10. Positive numbers indicate lower electric bills and savings.

1-4 Business Benefits

Businesses in the Connecticut and Western Massachusetts region will benefit significantly from a savings in electricity costs (Connecticut congestion charge fees and Massachusetts RMR fees). As detailed previously, benefits are realized as the savings in the Connecticut congestion charges exceed $100 million. The scenarios where the estimated Connecticut congestion charge savings are $100 million and below do not produce savings to businesses as the electricity rate increase implemented to fund the project out-weighs the benefits. The savings realized by businesses in the Connecticut and Western Massachusetts region will decrease the cost of production and increase labor productivity. Consequently, this will increase the competitiveness of businesses in the region, allowing them to gain market share and increase production. The increases in production will boost employment levels and generate additional wealth in the region.

Table 11 shows the savings to businesses for each of the six Connecticut congestion charge savings scenarios with the fixed Massachusetts RMR savings included in each. The savings to businesses for the $150 million to $250 million Connecticut congestion charge savings scenarios represents the direct decrease in the cost of production to businesses in the Connecticut and Western Massachusetts regions. As noted earlier, labor productivity will also be positively impacted by the cost savings in the $150 million to $250 million congestion charge savings scenarios.

Table 11: Total and Average Business Savings in Cost of Electricity for each CT Congestion Savings Scenario, Connecticut and Western Massachusetts, 2013-2023

CT Congestion Charge Savings Scenario	Mass RMR Savings	Total Savings 2013-2023	Average Yearly Savings
CT $0 Congestion Charge Savings	$25 M RMR Savings	-$60,294,785	-$5,481,344
CT $50 M Congestion Charge Savings	$25 M RMR Savings	-$31,966,488	-$2,906,044
CT $100 M Congestion Charge Savings	$25 M RMR Savings	-$3,638,190	-$330,745
CT $150 M Congestion Charge Savings	$25 M RMR Savings	$24,690,107	$2,244,555
CT $200 M Congestion Charge Savings	$25 M RMR Savings	$53,018,405	$4,819,855
CT $250M Congestion Charge Savings	$25 M RMR Savings	$81,346,702	$7,395,155

Table 12 shows the total and average savings to the electrified rail transportation industry in Connecticut. As with the other businesses in Connecticut, shown above, savings begin to occur at the $150 million Connecticut congestion charge savings level.

Table 12: Total and Average Savings for Electrified Rail Transportation in CT[5]

CT Congestion Charge Savings Scenario	Mass RMR Savings	Total Savings 2013-2023	Average Yearly Savings
CT $0 Congestion Charge Savings	$25 M RMR Savings	-$10,139,514	-$921,774
CT $50 M Congestion Charge Savings	$25 M RMR Savings	-$5,426,219	-$493,293
CT $100 M Congestion Charge Savings	$25 M RMR Savings	-$712,925	-$64,811
CT $150 M Congestion Charge Savings	$25 M RMR Savings	$4,000,370	$363,670
CT $200 M Congestion Charge Savings	$25 M RMR Savings	$8,713,664	$792,151
CT $250M Congestion Charge Savings	$25 M RMR Savings	$13,426,959	$1,220,633

[5] This savings only applies to Connecticut which has electrified railroads whereas Western Massachusetts does not.

Table 13 shows the impact on labor productivity for major industry sectors in the Connecticut and Western Massachusetts region, as a result of each Connecticut congestion charge savings scenario. Labor productivity is defined as output per employee, and is calculated as output divided by employment. Labor productivity is affected by changes in relative labor intensity, labor access index, and national labor productivity. Labor productivity increases moderately as the cost saving to businesses increase. Under the $250 million Connecticut congestion charge savings scenario, labor productivity increases are greatest in the management of companies and enterprises, manufacturing, utilities, wholesale trade, and finance and insurance industries. These are export based and highly productive industries that benefit greatest from the cost savings on a per employee basis.

Table 13: Average Labor Productivity Changes (Output per Employee) by Major Industry Sector for each CT Congestion Charge Savings Scenario, Connecticut and Western Massachusetts, 2013-2023, July 2008 $'s

Industry Sector	Scenario 1 $0 M CT $25 M MA Savings	Scenario 2 $50 M CT $25 M MA Savings	Scenario 3 $100 M CT $25 M MA Savings	Scenario 4 $150 M CT $25 M MA Savings	Scenario 5 $200 M CT $25 M MA Savings	Scenario 6 $250 M CT $25 M MA Savings
Forestry, Fishing, Other	$0	$0	$0	$0	$1	$1
Mining	-$9	-$5	$0	$4	$9	$17
Utilities	-$11	-$8	-$6	-$4	-$1	$26
Construction	-$2	$1	$4	$7	$9	$12
Manufacturing	-$9	-$1	$7	$15	$23	$30
Wholesale Trade	-$11	-$5	$1	$6	$12	$18
Retail Trade	-$5	-$2	$0	$3	$5	$8
Transp, Warehousing	-$1	$0	$1	$3	$4	$5
Information	-$12	-$8	-$3	$2	$7	$11
Finance, Insurance	-$10	-$4	$3	$9	$15	$17
Real Estate, Rental, Leasing	-$2	$0	$2	$4	$6	$7
Profess, Tech Services	-$3	-$2	$0	$1	$3	$4
Mngmt of Co, Enter	-$30	-$15	$0	$15	$30	$45
Admin, Waste Services	-$5	-$3	$0	$2	$5	$8
Educational Services	-$2	-$1	$0	$1	$2	$3
Health Care, Social Asst	-$2	$0	$1	$2	$3	$5
Arts, Enter, Rec	-$3	-$2	$0	$2	$3	$5
Accom, Food Services	-$3	-$1	$0	$2	$4	$6
Other Services (excl Gov)	$2	$1	$0	$0	-$1	-$3

2. Results

2-1 Employment

For this study employment can be defined as a measure of jobs held in the Connecticut and Western Massachusetts economy. The REMI model uses the Bureau of Economic Analysis (BEA) concept of employment which accounts for full-time, part-time, and self-employed workers. Simulation results capture the direct, indirect, and induced employment impact of the project.

Figure 1 represents the net incremental change to employment in Connecticut and Western Massachusetts if NU invests in its electric transmission system and the subsequent congestion charge and RMR fee savings are realized. For all six simulations, an employment jog downward is seen in the transition between 2010 and 2012 as the direct capital expenditures are completed. Long-term impacts for three of the simulations, \$150 million, \$200 million, and \$250 million Connecticut congestion charge savings, are positive and primarily driven by the reduced cost of operating in the Connecticut and Western Massachusetts region. The three other simulations, \$100 million, \$50 million, and the no savings simulation, show a negative impact on employment levels in the time period beyond 2014. Because the increase in electricity costs to customers out-weighing the benefits of the capital investment, and subsequent congestion charge and RMR fee savings. The point where the benefits of the capital investment and savings in congestion charges lead to positive employment gains falls at the \$150 million in Connecticut congestion charge savings level.

Figure 1: Net Employment Impact (2009-2023), State of Connecticut and Western Massachusetts, by CT Congestion Charge Savings (thousands of jobs)

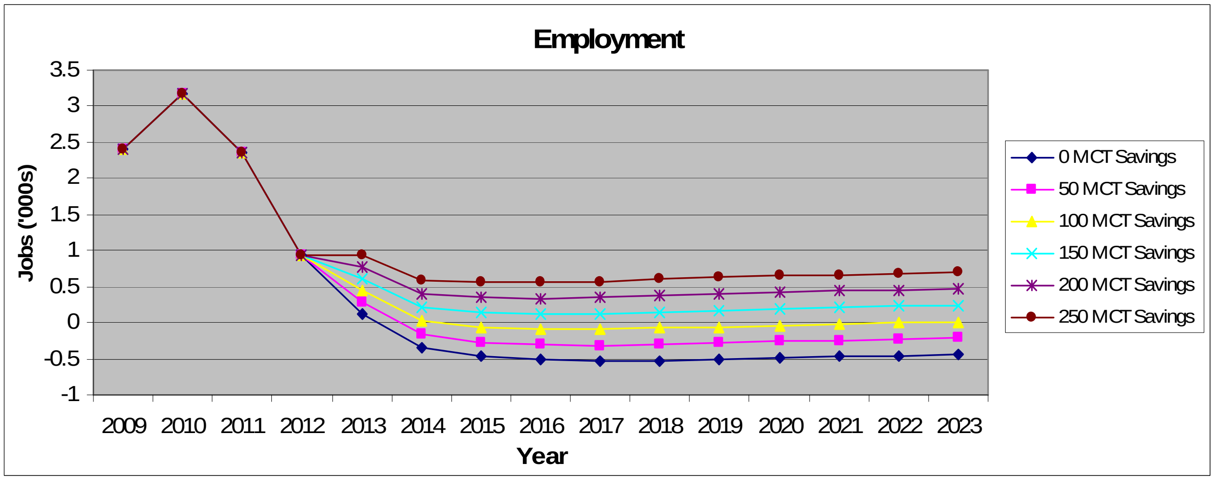


Table 14 provides details on the year-by-year change for the six scenarios. It is important to note that the six scenarios are identical with one another in the initial four years. This is due to the fixed levels of direct capital investment used as model inputs for each simulation. Over time, the lagged market response to product price change shifts employment opportunities to the Connecticut and Western Massachusetts economy and it is this responsive behavior that creates a divergence between the six simulations. As noted earlier, the three lesser congestion charge savings scenarios ($0 M - $100 M in Connecticut congestion charges savings) begin to show losses in employment in 2014 as the market responds to the increase in electricity prices. The three largest congestion charge savings scenarios show positive employment impacts throughout the time period. In 2023, the last year of our analysis, potential net new employment increases range between 691, 466, and 238 ($250 M, $200 M, and $150 M in Connecticut congestion charges savings, respectively).

Table 14: Annual Employment Change (2009-2023), State of Connecticut and Western Massachusetts

Employment	2009	2010	2011	2012	2013	2014	2015
Scenario 1	2,407	3,185	2,355	926	126	-348	-470
Scenario 2	2,407	3,185	2,355	926	287	-164	-267
Scenario 3	2,407	3,185	2,355	926	448	22	-63
Scenario 4	2,407	3,185	2,355	926	610	208	141
Scenario 5	2,407	3,185	2,355	926	772	396	346
Scenario 6	2,407	3,185	2,355	926	935	583	552

Employment	2016	2017	2018	2019	2020	2021	2022	2023	Average
Scenario 1	-520	-532	-524	-510	-491	-471	-452	-438	283
Scenario 2	-307	-313	-302	-284	-265	-246	-228	-213	438
Scenario 3	-93	-93	-78	-60	-38	-20	-2	11	594
Scenario 4	122	128	146	168	189	208	225	238	750
Scenario 5	338	350	371	394	417	436	453	466	907
Scenario 6	554	572	597	621	644	663	679	691	1,064

Note: Units are number of jobs. The values are year specific and should not be mistaken as a cumulative or additive concept.

Benefits that accrue from the NU investment vary across Connecticut and Western Massachusetts industries. During the physical investment period (2009-2012) a large share of the employment gains can be found in the construction sector. Though significant, this benefit is not sustainable, and Table 15 details each major sector's share of long-term (2019-2023) employment benefits as the average of all six scenarios. These benefits can be thought of as the future drivers of employment growth in Connecticut and Western Massachusetts due to improved electricity transmission and the subsequent savings in the Connecticut congestion charges and Massachusetts RMR fees.

The largest percent gain in employment can be found in industries that supply services (health care, retail trade, professional and technical services, and accommodations and food services). These employment gains are a secondary effect of the reduced operating costs for businesses that export, namely manufacturing, finance, and insurance. As export-based industries sell more to out-of-state buyers, employment and disposable income increases, thereby placing demands on

Connecticut's and Western Massachusetts' service sectors. This impact is classified as an induced employment impact (an impact that is derived from increased consumption). Section 2-2 details the connection between employment, demand, and production in more detail. It should also be noted that after the initial capital investment period construction employment dips below the baseline level as the economy shifts from the construction boom toward the more stable long-run economy, in which some simulations see higher electricity rates out-weighing benefits.

Table 15: Average Long-Term Employment Impact by Sector (2019-2023)

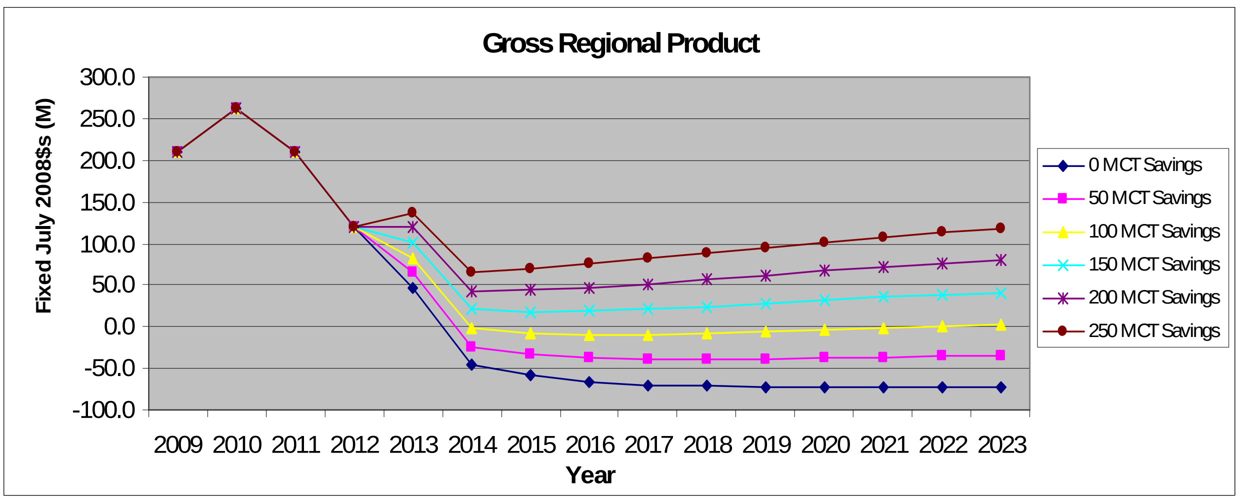
Sector	**Number of Jobs**	**% of Employment Impact**
Health Care and Social Assistance	21	31.40%
Retail Trade	16	23.64%
Professional and Technical Services	13	20.38%
Accommodation and Food Services	9	13.95%
Other Services (excluding Government)	9	13.33%
Administrative and Waste Services	8	11.64%
Manufacturing	6	9.07%
Wholesale Trade	4	5.96%
Real Estate, Rental, and Leasing	4	5.63%
Finance and Insurance	4	5.44%
Educational Services	3	4.96%
Information	3	4.44%
Arts, Entertainment, and Recreation	3	4.23%
Transportation and Warehousing	1	1.42%
Management of Companies and Enterprises	1	1.27%
Utilities	0	0.71%
Forestry, Fishing, and Other	0	0.10%
Mining	0	0.00%
Construction	-38	-57.57%
Total	**66**	**100.00%**

2-2 Gross Regional Product (GRP)

Gross regional product (GRP) is an economic accounting method that measures economic activity as a value-added or final demand concept. The value-added concept equals the output of the region (excluding intermediate inputs) and represents the compensation and profits within the regional economy. The final demand concept is equal to regional consumption + investment + government + (exports-imports). GRP is affected by changes in demand. When NU makes an investment in the transmission system, demand for construction labor, materials, and equipment increases. The long-term effect of reduced operating costs in Connecticut and Western Massachusetts is that the in-state industries are more attractive to buyers, and an increase in demand for Connecticut and Western Massachusetts goods and services boosts GRP. For this study, GRP for Connecticut is the same as its gross state product (GSP).

Figure 2 and Table 16 present the pattern of gross regional product development in an annual format. The six investment scenarios of the NU project place varying amounts of demand on the Connecticut and Western Massachusetts economy. The development of GRP is directly linked to the development of employment in the Connecticut and Western Massachusetts region, as workers are needed to produce products and goods to meet new demands.

Figure 2: Annual Gross Regional Product Change, (2009-2023), State of Connecticut and Western Massachusetts, by CT Congestion Charge Savings, Fixed July 2008$s (M)



All six scenarios show significant GRP generation during the capital improvement phase, as construction employment increases. As with employment, however, the long-term impacts on GRP for the $0 through $100 million Connecticut congestion charge savings is negative, while the $150 million through $250 million in savings scenarios have positive impacts. At the $250 million Connecticut congestions savings level, $1.86 billion in GRP will be generated over the 2009 to 2023 time period.

Table 16: Annual Gross Regional Product Change (2009-2023), by CT Congestion Charge Savings, Fixed July 2008$s (M)

Gross Regional Product	2009	2010	2011	2012	2013	2014	2015	2016
Scenario 1	208.9	262.8	210.6	120.7	46.9	-45.7	-58.8	-66.0
Scenario 2	208.9	262.8	210.6	120.7	64.8	-23.7	-33.4	-38.0
Scenario 3	208.9	262.8	210.6	120.7	82.9	-1.7	-8.0	-9.9
Scenario 4	208.9	262.8	210.6	120.7	100.9	20.6	17.8	18.4
Scenario 5	208.9	262.8	210.6	120.7	118.9	42.8	43.5	46.7
Scenario 6	208.9	262.8	210.6	120.7	137.1	65.1	69.3	75.2

Gross Regional Product	2017	2018	2019	2020	2021	2022	2023	Total	Avg
Scenario 1	-69.8	-71.5	-72.4	-72.7	-72.9	-72.9	-73.2	174.0	11.6
Scenario 2	-39.6	-39.6	-38.9	-38.0	-37.1	-36.0	-35.3	508.0	33.9
Scenario 3	-9.4	-7.6	-5.4	-3.1	-1.1	0.9	2.6	843.2	56.2
Scenario 4	21.0	24.5	28.3	31.7	35.2	38.2	40.8	1,180.2	78.7
Scenario 5	51.5	56.7	62.0	66.9	71.4	75.6	79.1	1,518.0	101.2
Scenario 6	82.1	89.1	95.7	102.0	107.6	112.7	117.2	1,856.1	123.7

Table 17 reports average percent changes to GRP-Value Added by major industry sector over all six scenarios. It is important to note that employment and GRP are linked, but the percent change in one category is not always equivalent in the other category. For instance, Table 17 shows that the manufacturing sector receives over 18% of the benefits as measured by GRP-Value Added, while its employment impact is just 9.1% of total employment (see Table 15).

This distinction calls our attention to how each sector of the economy has different output per worker rates. Highly productive sectors, such as the manufacturing, finance, and insurance industries, require fewer units of labor to produce a dollar-equivalent amount of product versus a lower productivity sector. It is this connection between output and labor that determines total employment needs. Conversely, the health care and social assistance industry receives only 11.8% of the GRP-Value Added but receives the highest share (31.4%) of employment gains. The reason for this can be traced to the lower productivity rates within the industry and induced employment gains due to consumer spending. It should also be noted that the average long-term GRP impact for construction is negative. This is a result of the negative long-term employment impact in construction, as discussed earlier and as shown in Table 15.

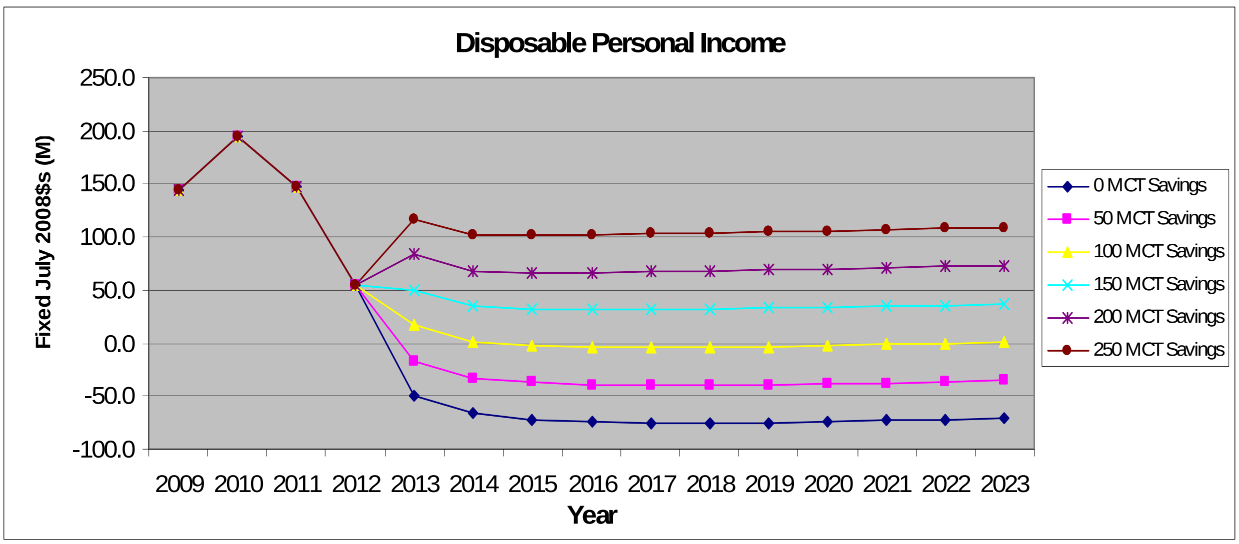
Table 17: Average Long-Term GRP-Value Added Impact by Sector (2019-2023)

Sector	Change in GRP (Millions)	% of GRP Impact
Manufacturing	$2,672	18.33%
Retail Trade	$2,049	14.05%
Wholesale Trade	$1,745	11.97%
Professional and Technical Services	$1,736	11.91%
Health Care and Social Assistance	$1,725	11.84%
Finance and Insurance	$1,613	11.06%
Real Estate, Rental, and Leasing	$1,238	8.49%
Information	$1,034	7.09%
Administrative and Waste Services	$570	3.91%
Management of Companies and Enterprising	$556	3.81%
Other Services (excluding Government)	$447	3.07%
Accommodation and Food Services	$413	2.84%
Utilities	$335	2.30%
Arts, Entertainment, and Recreation	$156	1.07%
Educational Services	$153	1.05%
Transportation and Warehousing	$147	1.01%
Mining	$4	0.03%
Forestry, Fishing, and Other	$1	0.01%
Construction	-$2,016	-13.83%
Total	**$14,577**	**100.00%**

2-3 Disposable Personal Income

Disposable Personal Income is a measurement of after-tax income, a large portion of which is spent in the regional economy. This concept can be loosely interpreted as "take home" pay. Personal Income is primarily derived from wage and salary disbursements (paychecks), transfer payments from government to individuals, dividends, interest, rents, and proprietors' income. Contributions to social insurance programs and income taxes are subtracted from personal income with the end product being disposable personal income. Figure 3 provides information on the annual change of disposable personal income in Connecticut and Western Massachusetts due to NU investments and the subsequent estimated savings in the Connecticut congestion charge and Massachusetts RMR fees.

Figure 3: Annual Disposable Personal Income Change (2009-2023), State of Connecticut and Western Massachusetts, by CT Congestion Charge Savings, Fixed July 2008 M $'s



Disposable Personal Income drives regional consumption and, as the economy reacts to the increased demand for labor, employment increases in most sectors, as does the average annual compensation rates (wage & salary plus benefits). The combined effect of increased employment and a higher compensation rate provides Connecticut and Western Massachusetts residents with more discretionary income. The impacts on disposable income among the six Connecticut congestion charge savings scenarios are similar to the impacts on employment and GRP; the $0 to $100 million in savings scenarios produce long-term negative impacts while the $150 million to $250 million in congestion savings scenarios produce positive impacts in the long term. Total disposable income generated over the period, under the $250 million in Connecticut congestion savings scenarios, equals $1.7 billion.

Often total disposable personal income changes are reported in per capita units since this format allows for easier interpretation of macroeconomic changes by the reader. Table 18 provides information on average annual per capita disposable income increases. The $250 million in

Connecticut congestion savings scenario produces a $12 average increase in per capita disposable income across the Connecticut and Western Massachusetts region.

Table 18: Average Annual Per Capita Disposable Income Change (2009-2023), Fixed July 2008 $s

Scenario	Connecticut Savings	Mass Savings	Per Capita Change
Scenario 1	$0 M	$25 M	-3
Scenario 2	$50 M	$25 M	0
Scenario 3	$100 M	$25 M	3
Scenario 4	$150 M	$25 M	6
Scenario 5	$200 M	$25 M	9
Scenario 6	$250 M	$25 M	12

2-4 State Revenue

As the Connecticut and Western Massachusetts economy expands due to NU's direct capital expenditures into the system and the subsequent long-term increase in business competitiveness is realized, additional tax revenues for the state governments are collected. The sources of the collections include increases in sales transactions, income, profits, licenses, and other fees. Tables 19 and 20 show the estimated total and annual average state revenues for Connecticut and Massachusetts from the income and sales tax, respectively, that develop during the analysis period (the regional total is also shown). As stated above, additional tax revenue will also be generated from corporate profits, licenses, and other fees; these are not included in the estimates below.

Income tax revenue is estimated by applying the effective income tax rate for each state to the personal income generated. The effective income tax rate (the state income tax rate less exemptions) was estimated to equal 4.0% for Connecticut and 4.7% for Massachusetts.

Under all estimated Connecticut congestion charge scenarios, positive revenue collection from the income tax is experienced. For the $250 million Connecticut congestion charge savings scenario, Connecticut state revenues from the income tax increase an estimated average of $2.7 million a year over the period, while in Massachusetts the average is $1.1 million.

Table 19: Total and Annual Average Estimated Income Tax Revenue, Connecticut & Massachusetts, by CT Congestion Charge Savings, 2009-2023, Nominal $'s

Scenario	CT Total 2009-2023	CT Annual Average	MA Total 2009-2023	MA Annual Average	CT & MA Total 2009-2023	CT & MA Annual Average
Scenario 1	$3,168,080	$211,205	$16,101,777	$1,073,452	$19,269,857	$1,284,657
Scenario 2	$10,687,600	$712,507	$16,311,256	$1,087,417	$26,998,856	$1,799,924
Scenario 3	$18,227,400	$1,215,160	$16,517,680	$1,101,179	$34,745,080	$2,316,339
Scenario 4	$24,962,800	$1,664,187	$16,720,814	$1,114,721	$41,683,614	$2,778,908
Scenario 5	$33,429,600	$2,228,640	$16,926,909	$1,128,461	$50,356,509	$3,357,101
Scenario 6	$41,038,000	$2,735,867	$17,128,351	$1,141,890	$58,166,351	$3,877,757

Table 20 shows the total and annual average estimated sales tax revenue collected. Sales taxes were estimated by applying the state sales tax rate (6% in Connecticut and 5% in Massachusetts) to the consumption results, by category, from the model. The sales tax was applied only the categories (or goods) that are taxed in each state.

Under the $250 million Connecticut congestion charge savings scenario, it is estimated that Connecticut will see an annual average increase of $1.1 million in sales tax collections over the study time period, while in Massachusetts the annual average increase will equal roughly $183,000.

Table 20: Total and Average Annual Estimated Sales Tax Revenue, Connecticut & Massachusetts, by CT Congestion Charge Savings, 2009-2023, July 2008 $'s

Scenario	CT Total 2009-2023	CT Annual Average	MA Total 2009-2023	MA Annual Average	CT & MA Total 2009-2023	CT & MA Annual Average
Scenario 1	-$4,395,804	-$293,054	$2,495,304	$166,354	-$1,900,501	-$126,700
Scenario 2	-$242,178	-$16,145	$2,545,576	$169,705	$2,303,398	$153,560
Scenario 3	$3,937,371	$262,491	$2,593,494	$172,900	$6,530,865	$435,391
Scenario 4	$8,137,029	$542,469	$2,642,011	$176,134	$10,779,040	$718,603
Scenario 5	$12,337,774	$822,518	$2,690,770	$179,385	$15,028,544	$1,001,903
Scenario 6	$16,548,434	$1,103,229	$2,737,726	$182,515	$19,286,159	$1,285,744

3. Conclusion

Maintaining and enhancing the quality and reliability of electricity is paramount in developing the Connecticut and Western Massachusetts economy. This analysis demonstrates that long-term economic benefits accrue in the majority of industries if NU makes investments in its electricity transmission system for the NEEWS project. By providing a balanced analysis and accounting for direct costs and benefits, an intelligible economic argument can be made in favor of proceeding with the NEEWS project, if after the improvements are made, subsequent savings in Connecticut congestion savings charges and Massachusetts RMR fees are realized by consumers. As noted throughout this report, as savings to consumers increase, so do economic benefits. In particular, savings above $100 million in Connecticut congestion charge fees (while maintaining a $25 million savings in Massachusetts RMR fees) produce sustained long-term economic benefits to the Connecticut and Western Massachusetts region. Savings at or below $100 million only produce short-term economic benefits during the construction period as the long-term gains are negated by the increase in the electricity rate.

Infrastructure is the support mechanism for economic growth, and by investing in the upgrade of the regional electrical system, NU is taking a proactive approach that will boost the Connecticut and Western Massachusetts economy. Often, fee or price increases are considered inherently negative, but this perspective leads to presumptuous criticism of any policy change. By applying a dynamic impact model, short- and long-term effects are quantified, and a complete analysis allows us to conclude that, with all factors considered, the NU investment in the NEEWS project will improve the long-term business climate in Connecticut and Western Massachusetts if over $100 million in Connecticut congestion charge fee savings and $25 million in Massachusetts RMR fee savings are produced.

It is important to note that this analysis did not attempt to quantify the benefits of improving overall transmission reliability, e.g., the savings from avoiding a blackout. The NEEWS project will lead to higher quality transmission and delivery of electricity which in and of itself will be beneficial to local consumers and businesses. Furthermore, this analysis does not include environmental impact savings and the benefits of enhanced access to renewable energy resources, which would reduce alternative compliance payments. Through the above, the NEEWS project will have greater benefits than those already outlined in this report.

Appendix

A-1 REMI Policy Insight

REMI Policy Insight is a structural economic forecasting and policy analysis model. It integrates input-output, computable general equilibrium, econometric, and economic geography methodologies. The model is dynamic, with forecasts and simulations generated on an annual basis and behavioral responses to wage, price, and other economic factors.

The REMI model consists of thousands of simultaneous equations with a structure that is relatively straightforward. The exact number of equations used varies depending on the extent of industry, demographic, demand, and other detail in the model. The overall structure of the model can be summarized in five major blocks: (1) Output and Demand, (2) Labor and Capital Demand, (3) Population and Labor force, (4) Wages, Prices and Costs, and (5) Market Shares. The blocks and their key interactions are shown in Figures A-1 and A-2

REMI Model Linkages

(Excluding Economic Geography Linkages)

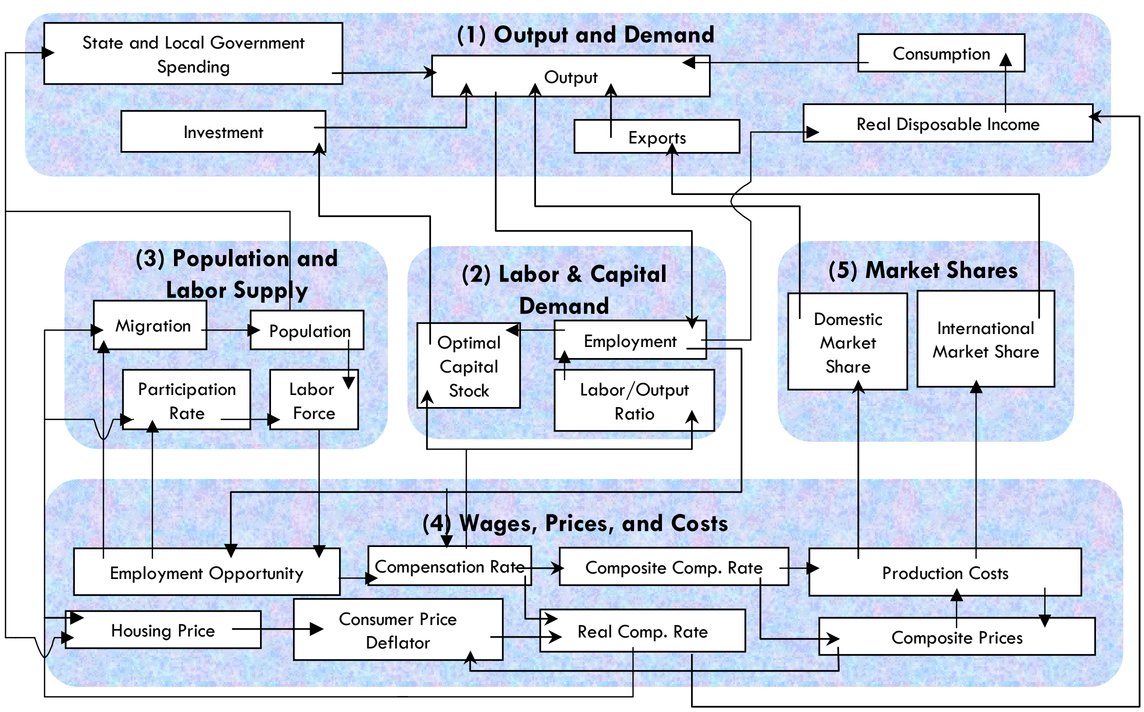


Figure A-1

Block 1. Output and Demand

This block includes output, demand, consumption, investment, government spending, import, product access, and export concepts. Output for each industry in Connecticut is determined by industry demand in the Connecticut and its trade with the rest of the US and International markets.

For each industry, demand is determined by the amount of output, consumption, investment and capital demand on that industry. Consumption depends on real disposable income per capita, relative prices, differential income elasticities and population. Input productivity depends on access to inputs because the larger the choice set of inputs, the more likely that the input with the specific characteristics required for the job will be formed. In the capital stock adjustment process, investment occurs to fill the difference between optimal and actual capital stock for residential, non-residential, and equipment investment. Government spending changes are determined by changes in the population.

Block 2. Labor and Capital Demand

The labor and capital demand block includes the determination of labor productivity, labor intensity and the optimal capital stocks. Industry-specific labor productivity depends on the availability of workers with differentiated skills for the occupations used in each industry. The occupational labor supply and commuting costs determine firms' access to a specialized labor force.

Labor intensity is determined by the cost of labor relative to the other factor inputs, capital and fuel. Demand for capital is driven by the optimal capital stock equation for both non-residential capital and equipment. Optimal capital stock for each industry depends on the relative cost of labor and capital, and the employment weighted by capital use for each industry. Employment in private industries is determined by the value added and employment per unit of value added in each industry.

Block 3. Population and Labor Force

The population and labor force block includes detailed demographic information about the region. Population data is given for age and gender, with birth and survival rates for each group. The size and labor force participation rate of each group determines the labor supply. These participation rates respond to changes in employment relative to the potential labor force and to changes in the real after tax compensation rate. Migration includes retirement, military, international and economic migration. Economic migration is determined by the relative real after tax compensation rate, relative employment opportunity and consumer access to variety.

Block 4. Wages, Prices and Costs

This block includes delivered prices, production costs, equipment cost, the consumption deflator, consumer prices, the price of housing, and the wage equation. Economic geography concepts account for the productivity and price effects of access to specialized labor, goods and services.

These prices measure the price of the industry output, taking into account the access to production locations. This access is important due to the specialization of production that takes place within each industry, and because transportation and transaction costs differ due to distance. Composite prices for each industry are then calculated based on the production costs of supplying regions, the effective distance to these regions, and the index of access to the variety of output in the industry relative to the access by other uses of the product.

The cost of production for each industry is determined by cost of labor, capital, fuel and intermediate inputs. Labor costs reflect a productivity adjustment to account for access to specialized labor, as well as underlying compensation rates. Capital costs include costs of non-residential structures and equipment, while fuel costs incorporate electricity, natural gas and residual fuels.

The consumption deflator converts industry prices to prices for consumption commodities. For potential migrants, the consumer price is additionally calculated to include housing prices. Housing price changes from their initial level depend on changes in income and population density.

Compensation changes are due to changes in labor demand and supply conditions and changes in the national compensation rate. Changes in employment opportunities relative to the labor force and occupational demand change determine compensation rates by industry.

Block 5. Market Shares

The market shares equations measure the proportion of local and export markets that are captured by each industry. These depend on relative production costs, the estimated price elasticity of demand, and effective distance between the home region and each of the other regions. The change in share of a specific area in any region depends on changes in its delivered price and the quantity it produces compared with the same factors for competitors in that market. The share of local and external markets then drives the exports from and imports to the home economy.

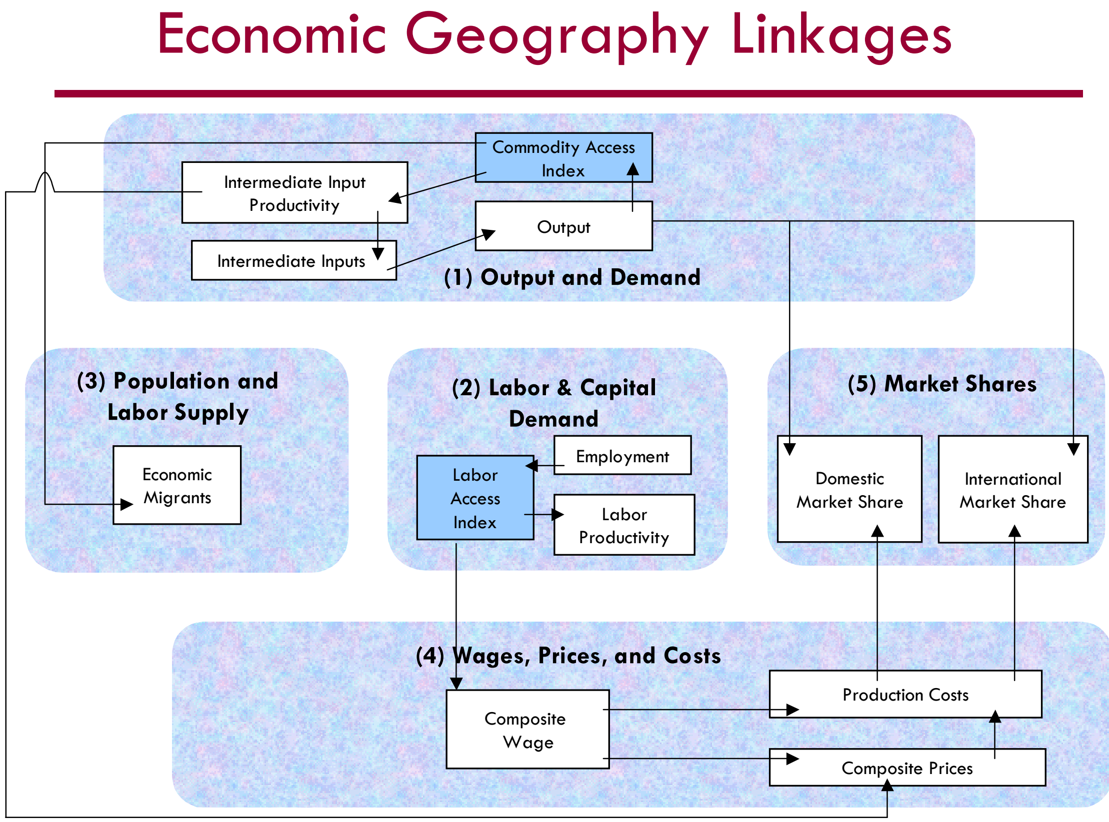


Figure A-2

As shown in Figure A-1 and A-2, the Labor and Capital demand block includes labor intensity and productivity as well as demand for labor and capital. Labor force participation rate and migration equations are in the Population and Labor Force block. The Wages, Prices and Costs block includes composite prices, determinants of production costs, the consumption price deflator, housing prices, and the wage equations. The proportion of local, inter-regional and export markets captured by each region is included in the Market Shares block.

Figure A-3 shows the policy simulation process for a scenario called Policy X. The effects of a scenario are determined by comparing the baseline REMI forecast with an alternative forecast that incorporates the assumptions for the scenario. The baseline REMI forecast uses recent data and thousands of equations to generate projected economic activity for a particular region. The policy variables in the model are set equal to their baseline value (typically zero for additive variables and one for multiplicative variables) when solving for the baseline forecast. To show the effects of a given scenario, these policy variables are given values that represent the direct effects of the scenario. The alternative forecast is generated using these policy variable inputs.

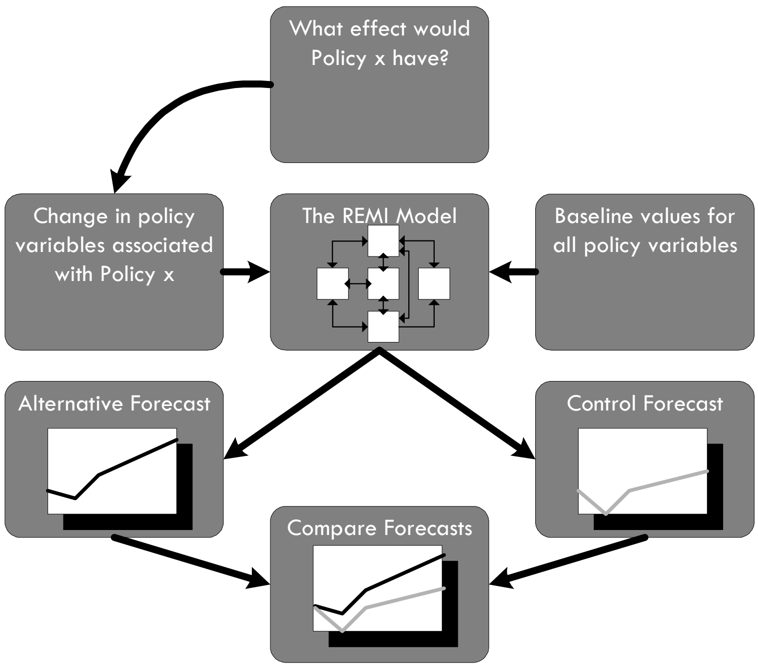


Figure A-3 Policy X scenario

Please note that the REMI Policy Insight model is not a cyclical short-run planning tool, but an economic impact tool.