STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
PUBLIC UTILITIES COMMISSION

RE: SB 2015-06, INVENERGY THERMAL DEVELOPMENT, LLC APPLICATION TO CONSTRUCT AND OPERATE THE CLEAR RIVER ENERGY CENTER, BURRILLVILLE, RHODE ISLAND

Pre-filed testimony of Ralph Gentile and Marc Vatter

Executive Summary

The Construction Labor Market Analyzer (CLMA) is a labor market consulting group that, among other things, analyzes the demand for the skilled construction trades based on projects in the construction queue; that is, projects under construction or planned for construction during future years. Our focus is primarily on employment impacts, especially those in the building trades. We used CLMA data for a standard 1,000 megawatt combined cycle power plant, modified to reflect recent changes to the timetable for the Clear River Energy Center (CREC), to examine its direct job impacts. We did some brief work using the National Renewable Energy Laboratory's Jobs and Economic Development Impact Model (JEDI), used by Ryan Hardy of PA Consulting and Edinaldo Tebaldi of Bryant University in their testimony for Invenergy Thermal Development LLC ("Invenergy"), to verify the reasonableness of the relationship among different types of effects on output and value added. In addition, we performed an independent analysis using the Organization for Economic Cooperation and Development's (OECD) Structural Analysis (STAN) database[1] and a study done for the Energy Information Administration (EIA) by R.W. Beck, Inc.[2]

Our analysis indicates that the construction of CREC supports the Hardy and Tebaldi testimonies in terms of job creation. If anything, it suggests higher numbers of jobs. The CLMA data provide for an average of 328 jobs per year in the trades alone during the construction period. Since the trades comprise only one

[1] http://stats.oecd.org/Index.aspx?DataSetCode=STAN08BIS, accessed March 31, 2010.

[2] "Updated Capital Cost Estimates for Electricity Generating Plants", prepared by R.W. Beck for the U.S. Department of Energy, Energy Information Administration, Office of Energy Analysis, November 2010.

segment of construction workers, and there will be other types of workers as well employed at the site, total direct jobs on site will be higher.

Noting that a ramp-up in jobs associated with CREC does not occur until the close of 2018, there is a dove-tailing in demand that could lend stability to the construction trades in Rhode Island over the years 2018-2020. A crucial point is that, even if markets are tight, and a skilled worker moves from one job to a CREC job, wages are likely to increase. Since benefits and related costs like worker's compensation are usually calculated as percentages of wages, accepting a job to work on CREC will lift a worker's wage and benefits.

We regard the value added multipliers from JEDI as reasonable for the state of Rhode Island. The output multipliers are close to the value added multipliers, so we regard them as reasonable, as well.

We also examine the labor-intensity of different generating technologies nationwide. In this analysis, gas-fired generation employs more workers per dollar of spending than any other generating technologies, except solar photovoltaic and hydroelectric. While local employment impacts may be of primary interest, just as Rhode Island's government is interested in the state's contribution to global emissions of CO_2, it is also worth noting that natural gas compares favorably to other generating technologies in terms of employment impacts, when one accounts for impacts within and beyond the Rhode Island state line. This result does not depend on the current, low price of natural gas persisting into the future. It results from upstream employment in pipeline construction and extraction.

We regard Hardy and Tebaldi's estimates of the local impacts on employment and value added of CREC as reasonable. They estimate that construction and operation of CREC will create more than 605 jobs per year during 2018-2021 in Rhode Island, and 129 jobs per year thereafter, not accounting for the effects of lower electricity prices. We estimate that construction and operation of CREC would create 852 jobs per year, directly and indirectly, locally, during 2018-2021. The 852 does not include any of the secondary "induced" effects included in Hardy and Tebaldi's estimate. For the same period, we estimate impacts on value added of about $154 million per year. This does not include any effects of lower electricity prices, which *are* included in Hardy and Tebaldi's estimated $133 million per year effect on output for 2018-2021.

1. INTRODUCTION

Q. Please state your name, business title and business address.

My name is Ralph Gentile, Ph.D. I am Senior Economist for the CLMA, 2393 Alumni Drive, Lexington, KY 40517. My personal address is 108 Pine Street, Andover, MA 01810. I have been assisted in this testimony by Marc H. Vatter, Ph.D., an energy economist with extensive experience in the electrical utility industry. Marc's address is 9 Underhill Street, Nashua, NH 03060.

Q. On whose behalf are you testifying?

Our testimony is on behalf of the Rhode Island Building and Construction Trades Council (RIBCTC) in support of the Invenergy application for a license from the Rhode Island Energy Facilities Siting Board ("EFSB" or the "Board") to construct the CREC project in Burrillville, Rhode Island.

Q. Please describe your educational background and your professional experience.

I (Ralph Gentile) am employed as a consultant at the CLMA. I have a Ph.D. from the University of Pennsylvania. I was an assistant professor in the Economics Department of UMass Lowell before working for 25 years as an economist at the McGraw-Hill Construction Information Group. (A detailed description of my educational background and professional experience is included as Exhibit RG-1.)

Marc Vatter is a consulting economist with extensive experience in the electric utility industry. (A detailed description of Marc's education and professional experience is included as Exhibit MV-1.)

Q. What is the Construction Labor Market Analyzer?

The CLMA is a labor market consulting group that, among other things, analyzes the demand for the skilled construction trades based on projects in the construction queue; that is, projects under construction or planned for construction during future years.

Q. Can you please describe the individuals' experience with skilled construction trades and power markets?

Ralph Gentile is primarily a construction economist with training in regional economics. Since his retirement from McGraw-Hill's Construction Information Group, Ralph Gentile has written and run models of job demand and wage escalation for the skilled trades using CLMA data. Those models rely on CLMA's data collection and detailed profiles of demand for the skilled construction trades by project type, key to analyzing the tightness of labor markets for the trades.

Marc Vatter's most recent work includes production cost modeling of the electric power grids in Mexico and the Midcontinent ISO using AURORAxmp®. He has sponsored testimony before several regulatory commissions on rates, plant additions, etc.

Q. What is the purpose of your testimony in this proceeding?

Our testimony will support the socio-economic impact analysis presented by PA Consulting, whose principal, Ryan Hardy, and affiliate, Edinaldo Tebaldi, have already submitted testimony in favor of CREC, a 970 megawatt (MW) combined cycle dual fueled generation facility. It will cover the direct demand for construction workers, supervisory personnel, professionals, and operating personnel, as well as the derived demand for labor in building products and other material inputs. It will discuss the effects on incomes in the local economy. Also included are comments on the labor-intensity of combined cycle natural gas electricity generating plants compared to alternative generating technologies, as well as additional (independent) estimates of the employment impacts of CREC.

Q. Please provide an overview of your testimony.

Our testimony addresses six topics:

1. A description of the methodology used to estimate the employment impacts of CREC;
2. a discussion of direct construction jobs with reference to CLMA estimates for full time equivalent jobs by specific trade, along with an assessment of the demands on local labor markets for tradespeople;
3. the relative importance of the induced effects of CREC on output and value added in Rhode Island;
4. an assessment of labor-intensity of construction and operation of a plant like CREC relative to other generating technologies;
5. estimates of employment impacts within and beyond the Rhode Island state line;
6. a technical appendix.

2. METHODOLOGY

Q. What types of impacts do you estimate?

Our focus is primarily on employment impacts, especially those in the building trades, but we do discuss other socio-economic benefits associated with CREC.

Q. What tools were used to estimate these impacts?

Our primary source is estimates of employment impacts in the building trades from the CLMA. PA Consulting primarily relied on the National Renewable Energy Laboratory's (NREL) Jobs and Economic Development Impact Model (JEDI) to estimate employment impacts. They also used AURORAxmp®, a production cost model, and their New England capacity market model to estimate the impact of CREC on electricity prices, and used IMPLAN to examine the effects of the resulting ratepayer savings on the Rhode Island economy.

We use CLMA data for a standard 1,000 megawatt combined cycle power plant to elucidate the direct job impacts. We do some brief work using JEDI to verify the reasonableness of the relationship among different types of effects on output and value added.

In addition, we perform an independent analysis using the OECD's STAN database[3] and a study done for the EIA by R.W. Beck, Inc.[4] The OECD data contain information on value added and labor input for a large number of industrial categories, and the Beck study provides cost data for several expenditure categories and generating technologies.

Q. For what geographical area are effects estimated?

Regional Definition: The focus of the analysis is the State of Rhode Island, although parts of the Boston consolidated metropolitan area, specifically the Worcester metropolitan area, are within commuting distance. The JEDI modeling is Rhode Island-specific and accounts for the size of the state. We also examine impacts beyond the Rhode Island state line using the OECD and Beck data.

[3] http://stats.oecd.org/Index.aspx?DataSetCode=STAN08BIS, accessed March 31, 2010.

[4] "Updated Capital Cost Estimates for Electricity Generating Plants", prepared by R.W. Beck for the U.S. Department of Energy, Energy Information Administration, Office of Energy Analysis, November 2010.

Q. What types of effects are estimated?

In the methodology used here, the employment impacts come in multiple stages. The first set of impacts is called "direct effects"; these are jobs, income, output and fiscal benefits due to "onsite labor and professional services jobs". In terms of spending, it is money spent on labor for companies engaged in development and on-site construction and operation of power generation and transmission[5]. These jobs (and other effects) may be short-term, as in the case of construction jobs, or long-term, such as the operations and maintenance positions that exist throughout the life of the generation facility.

The second set of impacts is often called "indirect effects".[6] They are jobs, income, output and fiscal effects that are created due to the initial spending to build and operate a plant, not including that which is directly spent on labor. Indirect jobs include the jobs created to provide the materials, goods, and services required by the builders and operators of CREC.

The third set of effects is called "induced effects"[7]; these are secondary impacts on jobs, earnings, output and fiscal benefits created by household spending of income earned either directly from CREC or indirectly from businesses that are impacted by CREC.

In the analysis, the direct, indirect and induced effects are gross of any alternative employment that might obtain, where the level of alternative employment depends on conditions in the markets for the types of labor employed through CREC.

[5] Please see JEDI documentation, "Interpreting Results", first paragraph. http://www.nrel.gov/analysis/jedi/results.html, accessed August 1, 2017.
[6] Ibid. second paragraph.
[7] Ibid. third paragraph.

Q. What benchmarks did you use in assessing the reasonableness of the modeling results?

We studied the JEDI model, reviewing its methodology and examining its calculations. We compared its direct construction job estimates to the craft trade profiles from the CLMA's 1,000 MW combined cycle natural gas power plant example. The CLMA estimates are consistent with the direct, indirect, and induced effects estimated using JEDI. We also compared JEDI's employment impacts to those derived using the OECD and Beck data, and the latter are somewhat higher.

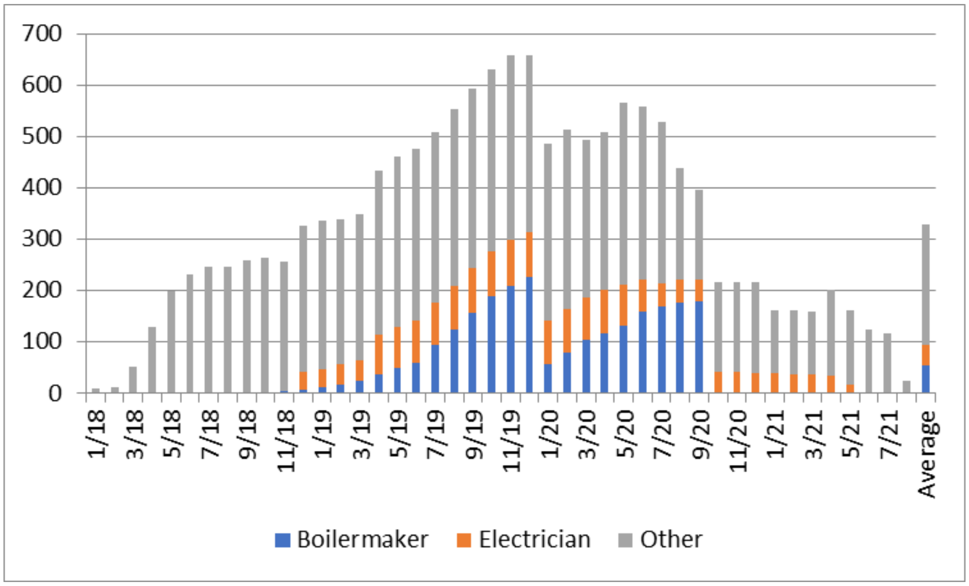
3. DIRECT IMPACTS ON THE TRADES

Q. Please provide a summary of CREC's impact on local employment in the trades.

Like the PA Consulting analysis, our analysis assumes 41 months of construction, beginning in January of 2018. This implies that the first 485 MW (half) of the plant will take two and a half years to construct, and the second 485 MW an additional year.

Our analysis indicates that the construction of the CREC supports the Hardy and Tebaldi testimonies in terms of job creation. If anything, it suggests slightly higher numbers of onsite construction jobs.

Figure 1: Direct Employment by Trade in Construction of CREC

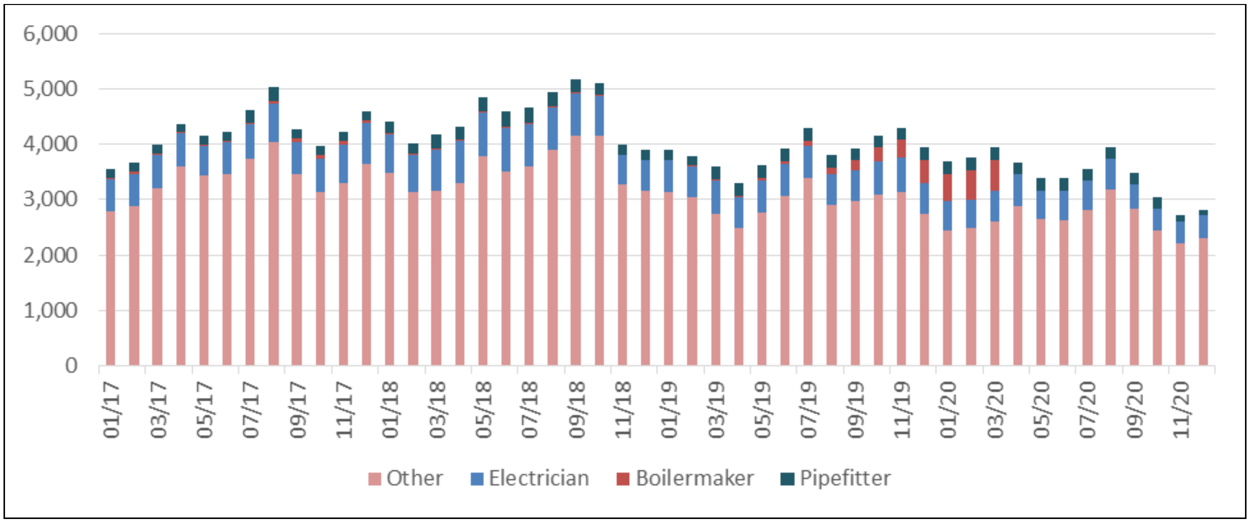


The CLMA estimates are for a standard 1,000 MW combined-cycle natural gas fired power plant built according to the construction schedule. They provide for an average of 328 jobs per year with total annual full-time equivalent jobs of 1,203, *in the trades.* (For details, please see Table 5 in Exhibit RG-2, which shows the breakdown of these jobs as per the CLMA estimates.) On page 28, lines 12-14 of his testimony, Hardy writes "The construction and operation of CREC alone – i.e., not including the electricity cost savings to the customer – will create an average of more than 605 full-time jobs per year from 2018-2021…", but this includes indirect and induced effects that go beyond the type of direct employment described in the CLMA data, so the estimate is reasonable in light of the CLMA data.

Q. How do the jobs that will be created by the CREC fit with the prospective demand for the skilled trades going forward?

Recruiting skilled craft workers can become difficult in tight labor markets, and it is important to understand the timing of demand at the local level. An examination of the Rhode Island-wide demand for the skilled trades suggests a resetting of demand at the end of 2018. Noting that the ramp-up in jobs for CREC does not occur until the close of 2018, there is a dove-tailing in demand that could lend stability to the construction trades in Rhode Island over the years 2018-2020.

Figure 2: Direct Employment by Trade for Rhode Island Skilled Workers



Q. Are the jobs that will be provided by Invenergy LLC be well-paid with benefits?

Actual wage and benefits for skilled trade jobs at the CREC will be subject to negotiation under a Project Labor Agreement. However, there is information that bears on the question of compensation.

The Occupational Employment Statistics (OES) from the Bureau of Labor Statistics provide annual estimates of wages for individual occupations by state. For the construction trades, the dispersion between median and upper percentile wages is large, with the higher percentiles generally occurring in the commercial and industrial construction project types. In particular, industrial projects require very skilled workers, since, for example, the correct installation and testing of high voltage components and pressure vessels is extremely important. The result is substantial wage premia for these workers.

For a selected set of trades,

Table **1** presents differentials for Rhode Island workers. The crucial point is that, even if markets are tight and a skilled worker moves from one job to another at CREC, wages are likely to increase. Since benefits and related costs like workers compensation are usually calculated as percentages of wages, accepting a job to work on CREC will lift a worker's wage and benefits.

Table 1: Distributions of Wage Rates for Selected Trades in Rhode Island; 2016

Occupational Title	State	Median Hourly Wage	90th Percentile Hourly Wage	% Diff
Construction Occupations	RI	24.89	38.75	56%
Carpenters	RI	24.16	37.07	53%
Cement Masons	RI	25.12	36.56	46%
Construction Laborers	RI	20.45	29.99	47%
Electricians	RI	25.54	36.72	44%
Insulation Workers	RI	37.77	48.49	28%
Painters, Construction and Maintenance	RI	19.25	24.27	26%
Plumbers, Pipefitters, and Steamfitters	RI	28.56	47.00	65%
Sheet Metal Workers	RI	25.02	38.84	55%
Structural Iron and Steel Workers	RI	34.69	39.33	13%

Q. What socio-economic benefits will accrue to Rhode Island in conjunction with the direct, indirect and induced jobs, along with the associated increases in state incomes and output?

Construction of the CREC will produce a broad range of benefits to the local community and the state. Locally, CREC will support stable families and lift demand for housing by providing long-term employment via its operations and maintenance jobs. By adding a major ratable to the tax base, CREC will raise town revenues. State-wide, it will sustain demand for the skilled trades in late 2018 when construction employment might otherwise be slipping. Also state-wide, it will lower the cost of electricity and reduce the likelihood of outages, enhancing the attractiveness of Rhode Island to businesses. Finally, an efficient, load-following electric generating plant like

CREC will make it possible to reliably fill the gaps inherent in generation from renewable sources, making it easier for the state to reduce emissions. The tax revenue associated with CREC can fund public goods such as education, drug treatment, and recreational facilities, as decided in state and local budgeting processes. Public expenditures such as these strengthen the social fabric of the community.

Questions associated with the economic impacts of workers residing outside the state are likely moot. On page 3, lines 5-8 of his testimony, Michael F. Sabitoni, President of the Rhode Island Building and Construction Trades Council, writes:

> "If approved, this project will be constructed by hundreds of uniquely qualified skilled craftsmen and women from the seventeen (17) unions of the RIBCTC. Most of these workers will be from the local area. Moreover, the workers that work on this project will be deriving one-hundred percent (100%) of their household income from working on this facility."

Q. What will be the revenue impact of CREC on Rhode Island's tax receipts?

In terms of state revenues, CREC will make a significant contribution. Rhode Island derives income from taxing personal income at rates ranging from 3.75% to 5.99% and taxing corporate income at 9%. It imposes a sales tax of 7%. From these and other sources of revenue, Rhode Island will derive millions of dollars from the CREC.

All workers working in the State of Rhode Island owe personal income tax on their earnings at a marginal rate of 3.75%, up to an annual income of $60,550, and 4.75% for wages between $60,550 and $138,300. A conservative estimate of the impact of the CREC on state revenues due to the construction trades alone can gained by doing a few simple calculations. Based on the total 1,203 full-time construction jobs in the trades, assuming a work-year of 2,080 hours, and using the 90th percentile income from the 2016 Occupational Employment Survey for Rhode Island, each worker would contribute over $3,200 to state coffers, so that total gain to the state would be nearly $4.0 million. This estimate is for the trades alone, so adding the impacts of all additional direct, indirect and induced jobs, would create a much larger total. Specifically, jobs related to CREC would contribute state tax revenues of $30 million during construction, including $15 million in sales taxes, $11 million in individual income taxes, and $2 million in corporate income taxes, using data on the Rhode Island economy from the Census Bureau and the Federal Reserve, as well as our estimated $154 million in value added.[8]

4. RELATIVE IMPORTANCE OF THE INDUCED EFFECTS

Q. Did you do any calculations using the NREL's JEDI model, which Ryan Hardy and Edinaldo Tebaldi used to estimate local economic impacts of building and operating CREC?

Yes, briefly, in order to verify the reasonableness of those calculations. We populated JEDI with data on a generic combined cycle plant similar to CREC. We wanted to verify that the multipliers used to derive induced effects were reasonable. In NREL's definitions, this multiplier is the ratio of total effects to the sum of direct and indirect effects. We calculated the number for both output and value added[9], and for expenditures on both construction and operation. We found the following multipliers.

[8] See https://www.census.gov/govs/state/ and https://fred.stlouisfed.org/series/RINGSP, accessed August 2, 2017.
[9] "Value added" is the amount by which the value of an article is increased at each stage of its production, exclusive of initial costs. When summed over the entire supply chain, it is a measure of final output.

Table 2: Multipliers on Direct and Indirect Effects of Construction and Operation of CREC

	Output	Value Added
Construction	1.37	1.33
Operation	1.30	1.28

Q. How do you know if these multipliers are reasonable?

One way to put the multipliers for value added in perspective is to evaluate what we call the corresponding "marginal propensity to leak". That is, the implied fraction of each dollar received in Rhode Island that is either spent out of state or saved. For the construction value added multiplier, the implied fraction is 0.25. For the operational output multiplier, the implied fraction is 0.22. We regard these as reasonable for the state of Rhode Island. The output multipliers are close to the value added multipliers, so we regard them as reasonable, as well.

5. LABOR-INTENSITY BY GENERATING TECHNOLOGY

Q. Did you estimate employment impacts over a larger area and for different generating technologies?

We examined the labor-intensity of different generating technologies on a national level. Table **3** shows the results of an analysis originally done in 2011 by Economic Insight, Inc. for PacifiCorp, based on the OECD and Beck data. It shows dollars of spending per annual full time equivalent worker by generating technology and capital, fuel, and operations and maintenance expenditure categories.[10] The lower the number, the more workers are employed per dollar of spending. In this analysis, combined cycle gas-fired generation employs more workers per dollar of spending than any other generating technologies, except solar photovoltaic and hydroelectric. The effects correspond to the direct and indirect effects estimated using JEDI, with a key

[10] Unfortunately, oil-fired generation is not included. On page 14, lines 14-15 of his testimony, Hardy writes that Clear River would primarily replace coal- and oil-fired generation.

difference: Whereas JEDI was used to estimate local impacts, these estimates apply even when the supply chain extends out of state. By this criterion, gas-fired generation is among the most labor-intensive of the technologies.

Table 3: 2016$ of Spending on Electric Generators Per Annual Full Time Equivalent Worker

	Capital	Fuel	O&M	Total
Geothermal Binary	$142,352		$153,545	$150,309
Wind	$143,020		$156,931	$150,339
Solar Thermal	$140,918		$170,049	$164,587
Solar PV	$119,016		$149,957	$132,784
Nuclear	$132,710	$311,366	$149,759	$165,017
Coal	$132,862	$166,109	$156,931	$156,222
Coal with CCS	$138,237	$166,109	$156,931	$156,812
Natural Gas	$139,994	$136,906	$156,931	$138,577
Biomass	$136,689	$157,868	$156,931	$154,779
Hydroelectricity	$120,565		$156,931	$129,233
U.S. Economy				$121,650

Q. If solar PV and hydro employ more workers per dollar spent, why not rely on those technologies, rather than natural gas?

On page 12, lines 8-11 of his testimony, Hardy explains that load-following gas-fired generation and intermittent solar generation are more complements in production of electricity than substitutes. Solar generation produces energy when the sun shines, and gas-fired generation fills in the gaps between that output and load. As to hydropower, in terms of overall employment impacts, it is superior to gas, but there are other considerations in deciding what source of power to rely on. In particular, suitable hydro sites and transmission routes for importation of hydropower are limited in supply.

Q. Is it a problem that only direct and indirect effects, and not induced effects, are estimated in Table 3?

No. Especially when comparing technologies, induced effects can reasonably be assumed to be similar.

Q. Should the Rhode Island EFSB be interested in employment impacts outside the state?

Hardy points out on page 22, lines 14-20 of his direct testimony that "[The Regional Greenhouse Gas Initiative] recognizes that greenhouse gas emissions are a global issue, and not a localized emissions issue," and that Rhode Island was a leader in making the initiative a reality. On page 38, lines 24-25, he writes, with his own emphasis: "The Resilient Rhode Island Act was enacted to help reduce overall g*lobal* emissions regarding the *global* issue of climate change."

While local employment impacts may be of primary interest, just as Rhode Island's government is interested in the state's contribution to global emissions of CO_2, it is also worth noting that natural gas compares favorably to other generating technologies in terms of employment impacts, when one accounts for impacts within and beyond the Rhode Island state line.

Q. You said that the analysis was originally done in 2011. Have you updated it in any way?

We updated the price of natural gas and, insofar as it factors into the analysis, oil, as those elements are particularly relevant to the CREC project and volatile. We also replaced the Beck numbers with updated overnight capital and operations and maintenance costs for an advanced combined cycle plant from the EIA.[11]

Q. Does the result that natural gas compares favorably to other technologies in terms of employment impacts depend on the current, low price of gas persisting into the future?

No. We assume that the price of natural gas will be $6.50/MMbtu, in 2016 dollars. That is the levelized price of natural gas used in electric power generation from the EIA's *Annual Energy*

[11] See "Assumptions to the Annual Energy Outlook 2017", Table 8.2.

Outlook reference case forecast, which is often used in analysis throughout the energy industries. In that forecast, the 2017 price is $3.61/MMbtu (2016$), which is 59% lower than what we have assumed.

Q. Why, then, does natural gas compare favorably to other technologies in terms of employment impacts?

Gas-fired generation has large employment impacts that go beyond the generators themselves. First, natural gas pipeline construction creates a large number of jobs. Completion of the Algonquin Incremental Market (AIM) project notwithstanding, gas pipeline facilities in New England reach full loading during winter months. That CREC is being built as a dual fueled unit is in part a response to that constraint. It is reasonable to assume, then, that additional gas-fired generation will require additional pipeline capacity (and additional oil-fired generation may, as well). Some of these impacts will occur nearby. According to the Manhattan Institute,[12]

> Transportation costs are high for key materials used in exploration, drilling, and the construction of gas-processing plants and pipelines. Therefore, support industries, including well support, steel, sand and gravel, concrete, trucking, and scientific and engineering services, often arise locally. Most of these support activities are not easily outsourced to foreign suppliers. (p. 5)

Second, advances in hydraulic fracturing for shale gas have made the process of extraction more labor-intensive.

> As is not true of conventional oil and gas wells, shale energy output declines steeply during the first few years of production. As a result, operators must be continually drilling new wells. If the market price is strong, the large initial output generates high rates of return and

[12] Considine, T.J., Watson, R.W., and Considine, N.B. The Economic Opportunities of Shale Energy Development. *Energy Policy and the Environment* No. 9, Manhattan Institute, May 2011.

> continuous incentives to keep drilling. This is one reason that regional economies with shale plays are enjoying a boom in job creation, tax revenues, and income growth. (p. 1)

This is not to say that hydraulic fracturing is without environmental risks, but the focus of our testimony is on employment.[13] Upstream labor-intensity, not accounted for in Hardy and Tebaldi's estimates, will rise over time as shale gas replaces conventional gas.

> …the labor-intensive aspects of shale gas development accelerate over time and can persist for decades, if the reserves in place are large enough. (p. 5)

Q. Did you use these sources to estimate the employment impacts of CREC?

Yes. Table 6, included as Exhibit MV-2, shows nationwide employment impacts based on the OECD and Beck data by OECD industrial category. We assume a plant factor of 65%. We have endeavored to report impacts on the same temporal basis as Hardy and Tebaldi, but the "annual" impacts of operations on employment in pipeline transport should be interpreted loosely, as most of that employment occurs in the construction, rather than operations, of the pipelines.

Q. In light of the estimates in Table 6, do you regard Hardy's estimates of the local employment impacts of CREC as reasonable?

Yes, we do. On page 5, lines 18-21 of his testimony, Tebaldi reports estimates that construction and operation of CREC will create more than 605 jobs per year during 2018-2021, and 129 jobs per year in operations thereafter. These numbers include direct, indirect, and induced effects, but not the effects of lower electricity prices. Using the OECD and Beck data, suppose that, in construction, one counts a fourth of electrical and optical equipment and electrical machinery and apparatus not elsewhere classified, and all of fabricated metal products, except machinery and equipment, construction, and finance, insurance, real estate and business services as local.

[13] The Environmental Protection Agency's final report on the impacts of hydraulic fracturing on drinking water resources is available at https://cfpub.epa.gov/ncea/hfstudy/recordisplay.cfm?deid=332990, accessed August 2, 2017.

Then, the estimates in Table 6 imply that construction and operation of CREC would create 852 jobs per year, directly and indirectly, locally, during 2018-2021. The 852 does not include any of the induced effects in Hardy and Tebaldi's estimate of 605.

This result comports with the assessment of The Rhode Island Statewide Planning Program:

> "…the magnitude of the employment, earnings, and economic output benefits described by Invenergy are reasonable, or even low, and consistent with a finding of positive economic impact for the state."[14]

Suppose, in operation, one counts half of electrical and optical equipment and electrical machinery and apparatus not elsewhere classified, three fourths of sale, maintenance and repair of motor vehicles and motorcycles - retail sale of automotive fuel, transport and storage, and computer and related activities, and all of electricity, gas, and water supply as local. Then, the estimates in Table 6 imply that operation of CREC after 2021 would create 89 jobs per year, which also does not include any of the induced effects included in Hardy and Tebaldi's estimate of 129.

Q. Did you calculate corresponding estimates of value added?

Yes. Using the OECD and Beck data by industry and capital expenditure category, corresponding direct and indirect local impacts of construction and operations are about $116 million per year for 2018-2021. Applying the multiplier 1.33 from Table 2 gives total (direct, indirect, and induced) impacts on value added of about $154 million. This does not include any effects of lower electricity prices, which are included in Hardy and Tebaldi's estimated $133 million per year effect on output for 2018-2021 on page 28, line 21 of Hardy's direct testimony. Table 4 summarizes local impacts on employment during the construction years from the different sources.

[14] See Tebaldi's testimony, page 7, lines 8-10.

Table 4: Impacts on Annual FTE in Rhode Island 2018-2021

Source	Direct	Direct and Indirect	Direct, Indirect, and Induced	Lower Electricity Prices
CLMA	328			
OECD/Beck		852		
JEDI			605	
IMPLAN				75

Q. How do your results depend on your assumptions about construction lead time?

The base case assumption is that the first half of CREC would be built and commence operations in 29 months, and the second half would require an additional 12 months. According to Table 8.2 of the EIA's "Assumptions to the Annual Energy Outlook 2017", lead time for a 429 MW advanced combined cycle plant is 36 months. Accordingly, we might alternatively assume that the 970 MW CREC facility would require 53 months to construct. If so, construction and operation of CREC would create 619 jobs per year, directly and indirectly, locally, during 2018-2022, and about $112 million per year in value added, compared to which Hardy and Tebaldi's estimates are still reasonable. Allowing longer lead time also implies that there would be less pressure to fill construction jobs with workers from out of state, and that the jobs filled by Rhode Islanders would be longer in duration.

Q. How were the OECD and Beck data used to make these estimates?

Please see the technical appendix.

Q. Does this conclude your direct testimony?

Yes, it does.

7. TECHNICAL APPENDIX

Q. How are dollars per job calculated in the Economic Insight analysis?

The following discussion accompanies the analysis.

We begin with costs of capital, fuel, and O&M used to produce electric power by generating technology, from the Energy Information Administration (EIA) and other sources. We would like to estimate the total labor associated with production of that power and divide the costs by the labor to estimate the jobs associated with spending on the different technologies. We have a good idea which industries contribute labor to production of electric power for each generating technology, but we do not know how much labor each industry contributes, or the sum of those contributions. We describe a method here that uses data on value added and employment from the Organization for Economic Cooperation and Development (OECD), together with estimated costs from a study[15] done by R.W. Beck for EIA, to approximate the sum of those contributions and, therefore, dollars of spending per job.

We calculate dollars per unit of labor used to produce a "final" good as a weighted average of dollars per unit of labor in the industries that contribute intermediate goods. The method has two significant limitations. The first is that available data do not conform precisely to the cost streams (e.g. fuel costs of natural gas-fired generators) whose employment effects we would like to estimate. The adaptation is to use data for industries that overlap with those cost streams, or for industries where labor employs similar skills and physical capital. Industries that compete for labor with those feeding into generation using a technology of interest are good candidates. The second limitation is that we assume that value added per unit of labor employed in each

[15] "Updated Capital Cost Estimates for Electricity Generating Plants", prepared by R.W. Beck for the U.S. Department of Energy, Energy Information Administration, Office of Energy Analysis, November 2010.

industry is the same when producing intermediate goods used for electric power as when industry output is used to produce other goods.

The OECD STAN database provides valued added, employment, and labor compensation, among other data, for a large number of industrial categories. Using these, we have constructed data on value added per unit of labor for the industrial categories relevant to generation of electric power. We express cost per unit of labor contributed to production of one unit of a “final” good (e.g. natural gas delivered to a combined cycle generator) as a weighted average of value added per unit of labor employed producing each intermediate good (e.g. pipeline transport of natural gas):

$$\sum_{i=1}^{N} \frac{P_i Q_i}{L_i} a_i = \frac{\sum_{i=1}^{N} P_i Q_i}{\sum_{i=1}^{N} L_i} \tag{1}$$

$$\sum_{i=1}^{N} a_i = 1 \tag{2}$$

where there are N intermediate goods; a_i is the weight assigned to Intermediate Good i; P_i is its price *net of costs for preceding intermediate goods used to produce* Q_i units; L_i is the labor contributed to produce Q_i; and $P_i Q_i / L_i$, then, is value added per unit of labor. Value added over all intermediate goods equals cost of the final good, $C \equiv \sum_{i=1}^{N} P_i Q_i$.

For example, C could be fuel costs for electric power produced using natural gas, one of the $P_i Q_i$s could be the value added to production of that power from pipeline transport, and the corresponding L_i the labor contributed to transport the gas. From the OECD STAN database, we have value added per unit of labor, $P_i Q_i / L_i$, for “land transport - transport via pipelines”, and we have a forecast of costs for fuel from the EIA, the value for C. Thus, we have all but one of the data needed to quantify the weight we assign to value added per unit of labor for Intermediate Good i:

$$a_i = \frac{1}{N}\left(\frac{L_i}{P_iQ_i} \Big/ \frac{L}{C}\right) = \frac{L_i}{L}\frac{C}{N \times P_iQ_i} \quad (3)$$

where L is the sum of all labor contributed; $\sum_{i=1}^{N} L_i = L$. L is the datum we do not know before the fact, but we choose it to satisfy (2). In calculating this weighted average, dollars per unit of labor, P_iQ_i/L_i, are weighted in direct relation to units of labor per dollar. Plugging (3) into (1) gives

$$\begin{aligned}\sum_{i=1}^{N}\frac{P_iQ_i}{L_i}a_i &= \sum_{i=1}^{N}\frac{P_iQ_i}{L_i}\frac{L_i}{L}\frac{C}{N \times P_iQ_i} \\ &= \sum_{i=1}^{N}\frac{C}{LN} = N \times \frac{C}{NL} \\ &= \frac{C}{L}\end{aligned}$$

C/L is dollars of spending per unit of labor used to produce the final good, and multiplying it by the number of units of labor that constitute a "job" gives dollars per job.

Once the a_i's and L are known, employment impacts by industry can be derived using $L_i = La_i$. Value added is given by multiplying employment impacts by the weighted average of spending per job across expenditure categories from the Beck study.

Current Affiliations:
Research Associate, Institute for Construction Economic Research, Lansing, Michigan.
Principal Economist, Construction Labor Market Analyzer (myCLMA), Lexington, Kentucky.

Experience:
Principal Economist, (2015-present)
Construction Labor Market Analyzer
Forecasted skilled trade wage escalation rates for companies planning multi-year projects.
Analyzed and updated market prospects for petroleum, natural gas and commodity chemicals.

Senior Economist (1993-2014)
Research & Analytics Group, McGraw-Hill Construction
Wrote and maintained econometric models to forecast construction.
Produced detailed quarterly forecasts and special studies.
Designed and maintained databases for very large construction projects
Areas of Research:
Large Project Forecasts –methodology for using Dodge Reports information to forecast construction projects ($5+ million) to start.
Skilled Trades Forecasts – tool for estimating state and national demand for individual construction trades using occupational employment, census of construction, and Dodge starts data.
Product Demand Studies – designed methods to forecast demand for building products based on federal (input-output, economic census, put-in-place, and other) data.

Economist
Real Estate Analysis and Planning Service, McGraw-Hill Construction. (1989-1993)
Modeled and forecasted construction, rents and absorption for commercial and residential real estate in fifty metropolitan areas for the Real Estate Analysis and Planning Service. Also responsible for forecasting commercial and institutional building at the regional and national levels.

Assistant Professor.
Department of Economics, University of Massachusetts, Lowell, MA. (1984-1989)
Taught courses in microeconomics, macroeconomics, econometrics, statistics, and quantitative methods to undergraduate and graduate students. Conducted research on the geographic mobility for scientists, engineers and technical workers.

Research Associate (1981-1984)
Regional Science Research Center, Cambridge, MA
Responsible for providing research support for input-output models, methods and forecasts

Education:

1981	Ph.D.	University of Pennsylvania, Philadelphia, Pennsylvania
1976	M.A.	University of Pennsylvania, Philadelphia, Pennsylvania

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1973 B.A. Haverford College, Haverford, Pennsylvania

Selected Publications and Reports:

Skilled Trades Employment in the Pipeline Industry: 2006-2015. Institute for Construction Economic Research. June 2017.

State Economic, Wage and Per Diem Forecasts for Selected Construction Trades, 2016Q3, (Louisiana, Texas, and Beaumont-Port Arthur). Construction Labor Market Analyzer, (forthcoming), September 2016.

Natural Gas Prices and Construction. Oil and Gas Report #6, Construction Market Analyzer, July 2016.

Construction Prospects in the Intermediate and Long-Run. Oil and Gas Report, Construction Labor Market Analyzer, May 2016.

Employment, Wages, and Market Share Estimates for the National Association of Construction Boilermakers Employers - Great Lakes Division. Construction Labor Market Analyzer, April 2016.

State Economic, Wage and Per Diem Forecasts for Selected Construction Trades, 2016Q2, (Louisiana, Texas, and Beaumont-Port Arthur). Construction Labor Market Analyzer, February 2016.

The Industrial Recession: How Bad? Oil and Gas Report #4, Construction Labor Market Analyzer, February 2016.

Wage and Per Diem Forecasts for Selected Construction Trades, 2016Q1, (Louisiana, Texas, and Beaumont-Port Arthur). Construction Labor Market Analyzer, February 2016.

Reading the Tea Leaves: Capital Spending Along the Gulf Coast. Oil and Gas Report, Construction Labor Market Analyzer, November 2015.

Act Two: Low Energy Prices and Construction. Oil & Gas Report #2, Construction Labor Market Analyzer, September 2015.

Wage and Per Diem Forecasts for Selected Construction Trades, 2015Q3, (Louisiana, Texas, and Beaumont-Port Arthur). Construction Labor Market Analyzer, August 2015.

Wage and Per Diem Forecasts for Selected Construction Trades, 2015Q1, (Louisiana, Texas, and Beaumont-Port Arthur). Construction Labor Market Analyzer, February 2015.

Presentations and Older Reports:

Wage Escalation Rates for the Skilled Construction Trades – Some Practical Issues and Modeling Considerations. ICERES Research Symposium, July 21, 2016.

Improving Construction Demand Analytics. A Presentation. National Institute of Building Sciences, Washington, DC (December 12-13, 2013).

Transportation Infrastructure: Gearing Up for Change. *A McGraw-Hill Construction Special Report:* Principal in multiple author study. McGraw-Hill Construction Research and Analytics, (October 2009).

Forecasting Construction Labor Demand—A Working Model. *Paper Presented at Construction Economics Research Network, Washington, DC.* (December 6th, 2007).

Associations & Memberships: American Economic Association, National Association for Business Economics.

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EDUCATION

Ph.D. in Economics, Brown University, Providence, RI, 2006
M.A. in Economics, Brown University, Providence, RI, 1999
B.A. in Economics with departmental honors, University of Oregon, Eugene, OR, 1986

CONSULTING EXPERIENCE

Consulting Economist, Nashua, NH and Portland, OR, January 2010 – present

- Affiliated with Birch Energy Economics, Post Falls, ID, July 2015 – present
- Affiliated with Economic Insight, Sisters, OR, January 2010 – January 2013
- Used AURORAxmp® (xmp) to forecast wholesale electric prices in Michigan and sponsored testimony on behalf of Michigan Public Service Commission staff
- Recent work in newly restructured wholesale power market in Mexico
    - Used xmp to model expansion and operation of wholesale power grid for independent generators
    - Estimated Herfindahl-Hirschman indices of market concentration
    - Forecasted hourly loads and prices for power
    - Developed methodology and forecasted prices for clean energy certificates,
    - Developed methodology and forecasted prices for ancillary services
    - Adapted methodology and forecasted costs of congestion in a "zonal" model
- Used xmp to model electric resource planning in the Pacific Northwest
- Used xmp to estimate trade benefits of Entergy and South Mississippi Electric Power Association joining regional transmission organizations, sponsored testimony before the Mississippi Public Service Commission (MPSC)
- Assessed application to install pollution controls on coal plant; testified before the MPSC
- Estimated dollars of spending per employee by generating technology
- Analyzed issues regarding pricing and royalties in geothermal and natural gas leases in California and Texas;
- Analyzed pricing and alleged use of market power in California power crisis
- Edited several scholarly articles written by non-native speakers of English
- Estimated lost earnings in a wrongful death lawsuit and testified to report
- Edited scholarly research written by non-native speakers of English

Assistant consulting economist to personal injury and wrongful death litigants, Allan M. Feldman, Providence, RI, 2002-2003

- Worklife evaluation for litigation related to personal injury or wrongful death

Research Associate, Synapse Energy Economics, Cambridge, MA, July 1998 - February 1999

- Evaluated forecasts of electricity prices submitted in "stranded-cost" claim by four Maryland utilities

Associate Economist, Economic Insight, Portland, OR, May 1988 - September 1988

- Surveyed forecasts of electricity prices and estimates of demand elasticities related to litigation over Washington Public Power Supply System bond defaults

Technical Assistant, ECO Northwest, Eugene, OR, July 1986 - August 1987

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- Worklife evaluation for litigation related to personal injury and wrongful death; wrote company training manual on the subject

TEACHING EXPERIENCE

Visiting Assistant Professor of Economics, Universidad del Pacifico, Jesús María, Lima, Peru, September 2014

- Taught topical graduate course in Energy Economics

Visiting Assistant Professor of Economics, Pacific University, Forest Grove, OR, August 2008 - May 2009

- Taught principles of microeconomics, environmental economics, and international trade
  Lecturer in Economics, Eastern Connecticut State University, Willimantic, CT, August 2005 - May 2006
- Taught principles of microeconomics
  Teaching Assistant to Harl Ryder and others, Brown University, Providence, RI, September 1999 - May 2002
- Teaching Assistant for Principles of Micro- and Macroeconomics
- **Teacher, English as a Second Language**, Changsha Normal University of Water Resources and Electric Power, Changsha, Hunan, PRC, August 1987 - January 1988, Brown University, Providence, RI, Summer 2001

GOVERNMENTAL EXPERIENCE

Associate Economist, New York Department of Public Service, Albany, NY, August 2006 - December 2007

- Projects in energy conservation and pollution control

Industry Economist, Bonneville Power Administration, Portland, OR, May 1994 - June 1997

- Authored and testified to marginal cost analysis in 1996 rate case
  - Helped prepare inputs to and interpreted and applied results of Power Marketing Decision Analysis Model (PMDAM) to rate design and to planning and evaluation of generation and conservation resources
  - Prepared and conducted public meetings on analysis and its implications for rate design
  - Fielded and incorporated comments from a variety of participants
  - Authored rate case study, documentation, and testimony

Public Utilities Specialist, Bonneville Power Administration, Portland, OR, September 1988 - May 1994

- Conducted research on marginal costs of generating and marketing hydropower on the West Coast
- Prepared workshop briefing material, rate case studies, and documentation supporting Marginal Cost Analysis and other rate-related issues as assigned
- Evaluated contracts for disposition of wholesale power

RESEARCH

Title	Status	Availability
OPEC's Kinked Demand Curve	(2017) *Energy Economics*, 63, pp. 272-287.	https://doi.org/10.1016/j.eneco.2017.02.010
Macroeconomic Risk and Residential Rate Design	International Association for Energy Economics (IAEE) Working Paper No. 15-208; under review	http://ssrn.com/abstract=2596258
Social Discounting with Diminishing Returns on Investment	Under review	http://ssrn.com/abstract=1078502
The Impact of International Trade on Electric Loads in Mexico	IAEE Working Paper No. 17-301; non-technical version published in IAEE Energy Forum	http://ssrn.com/abstract=2928817 https://www.iaee.org/en/publications/newsletterdl.aspx?id=406
Stockpiling to Contain OPEC	Dissertation chapter; IAEE Working Paper No. 17-136; presented at 12/08 IAEE conference in New Orleans	http://ssrn.com/abstract=912311
OPEC's Demand Curve	Dissertation chapter; reviewed at http://knowledgeproblem.com/2008/05/14/	http://ssrn.com/abstract=1127642
The Cause and Effect of Exclusionary Zoning in Central Cities	Dissertation chapter; under review	http://ssrn.com/abstract=636962

Research Assistant to Allan M. Feldman, valuation of individual earning capacity, Brown University, 2000
Research Assistant to J. Vernon Henderson, industrial location in Indonesia, Brown University, Summer 1999

AWARDS

- Twelve monetary awards for job performance at Bonneville Power Administration
- Award for best undergraduate research project in economics at University of Oregon; examined deregulation of U.S. airline industry

Other Activities

Monitored the House Science, Technology, and Energy Committee in Concord, NH for the Northeast Energy and Commerce Association
Peer Reviewer for *Land Economics*: effects of endowments of petroleum resources on corruption, 2008; hedging in coal contracts under the acid rain program, 2010-11; suburban agriculture as an amenity, 2012; prorationing versus unitization in the U.S. petroleum industry in the 20th century
Founded and Managed "Micro Lunch" seminar, Brown University, 2001-2002
Role of Expert Witness in Lewis & Clark Law School's mock personal-injury litigation, 1996
Peer Advisor, Department of Economics, University of Oregon, 1984-1986

Memberships

American Economic Association; Association for Christian Economists; International and United States Associations for Energy Economics; Northeast Energy and Commerce Association; National Association of Forensic Economics; Editorial Freelancers Association

Exhibit RG-2

Table 5: Direct Employment by Trade in Construction of CREC

Craft	1/18	2/18	3/18	4/18	5/18	6/18	7/18	8/18	9/18	10/18	11/18	12/18	1/19	2/19	3/19	4/19	5/19	6/19	7/19	8/19	9/19	10/19	11/19
Boilermaker	0	0	0	0	0	0	0	0	0	2	3	5	8	12	15	22	29	34	51	67	83	98	108
Boilermaker Welder	0	0	0	0	0	0	0	0	0	0	0	3	3	6	9	15	21	26	42	57	74	91	102
Carpenter (Scaffold Builder)	0	0	0	0	16	32	32	32	32	32	31	31	30	30	29	28	27	26	25	24	23	22	21
Concrete Finisher / Cement Mason	0	0	17	52	69	69	68	66	65	62	60	58	56	52	50	46	44	42	37	34	31	29	27
Craft Helper	0	0	0	0	17	35	36	38	39	40	41	41	43	43	44	44	45	45	46	46	46	45	46
Electrician	0	0	0	0	0	0	0	0	0	0	0	35	36	39	41	77	80	81	84	86	87	87	88
Instrumentation Technician	0	0	0	0	0	0	0	0	0	0	0	8	8	8	8	16	17	17	18	18	18	18	19
Insulator	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	7	9	10
Ironworker (Reinforcing)	0	0	20	60	80	78	75	68	63	55	48	42	36	21	19	14	13	11	0	0	0	0	0
Ironworker / Welder (Structural)	0	0	0	0	0	0	17	18	35	38	38	40	41	42	42	43	43	43	42	41	40	39	38
Laborer	4	5	6	6	6	7	8	9	9	10	10	11	11	12	12	12	12	12	13	12	12	12	12
Lineman	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Millwright	0	0	0	0	0	0	0	0	0	0	0	0	5	13	16	19	29	36	43	50	55	60	65
Operator (Heavy Crane)	0	0	0	0	0	0	0	5	5	11	11	12	12	13	13	13	13	13	13	13	13	13	13
Operator (Heavy Equipment)	7	7	7	7	7	7	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Painter	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	3	3	5	7	9	11	13
Pipefitter	0	0	0	0	0	0	0	0	0	0	0	14	15	16	16	31	32	33	34	35	36	36	36
Pipefitter / Combo Welder	0	0	0	0	0	0	0	0	0	0	0	15	16	17	18	34	35	36	37	38	39	39	39
Sheet Metal Worker	0	0	0	0	0	0	0	0	0	3	3	3	6	7	8	9	10	10	13	13	14	15	16
Sum	11	12	50	125	196	228	242	243	255	261	255	325	335	339	348	435	461	478	511	553	595	633	660

Exhibit RG-2

Table 5: Direct Employment by Trade in Construction of CREC (continued)

Craft	12/19	1/20	2/20	3/20	4/20	5/20	6/20	7/20	8/20	9/20	10/20	11/20	12/20	1/21	2/21	3/21	4/21	5/21	6/21	7/21	8/21	Average
Boilermaker	116	31	43	55	62	68	81	85	88	89	0	0	0	0	0	0	0	0	0	0	0	23
Boilermaker Welder	111	25	36	49	56	64	79	84	88	90	0	0	0	0	0	0	0	0	0	0	0	20
Carpenter (Scaffold Builder)	19	19	17	16	16	14	13	13	8	7	7	7	6	6	6	5	5	4	4	4	0	23
Concrete Finisher / Cement Mason	17	16	14	13	12	11	9	9	8	0	0	0	0	0	0	0	0	0	0	0	0	45
Craft Helper	45	44	44	43	43	41	41	41	22	22	21	21	21	20	20	19	19	18	18	17	0	34
Electrician	87	87	86	84	83	80	63	45	44	43	42	41	41	39	38	37	35	17	0	0	0	36
Instrumentation Technician	19	19	19	19	19	18	18	18	17	10	10	9	9	9	9	9	8	8	8	8	8	8
Insulator	13	15	17	23	25	26	18	10	11	13	15	16	17	18	19	19	19	10	0	0	0	1
Ironworker (Reinforcing)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31
Ironworker / Welder (Structural)	21	21	20	19	19	19	17	17	16	0	0	0	0	0	0	0	0	0	0	0	0	28
Laborer	11	11	10	10	9	9	8	8	8	5	5	4	4	4	4	3	3	3	3	3	2	10
Lineman	0	0	0	0	0	50	55	60	0	0	0	0	0	0	0	0	50	55	60	56	0	0
Millwright	69	71	76	34	36	37	40	41	42	44	45	45	45	0	0	0	0	0	0	0	0	17
Operator (Heavy Crane)	12	7	7	7	6	6	6	6	6	5	0	0	0	0	0	0	0	0	0	0	0	8
Operator (Heavy Equipment)	8	8	7	7	7	7	5	4	4	4	4	4	3	3	3	3	3	2	0	0	0	8
Painter	18	22	27	32	33	34	23	11	12	16	20	21	23	26	27	27	27	14	0	0	0	2
Pipefitter	37	36	36	36	36	36	35	35	34	19	18	18	18	18	17	17	17	16	16	16	15	15
Pipefitter / Combo Welder	39	39	39	38	38	37	37	36	20	20	20	19	19	18	18	18	17	17	16	15	0	16
Sheet Metal Worker	17	17	18	8	9	9	9	9	10	10	10	10	10	0	0	0	0	0	0	0	0	6
Sum	660	488	515	493	509	568	560	531	439	397	216	216	216	162	160	159	203	164	126	119	24	328

Table 6: Nationwide Employment Impacts of CREC

(annual full time equivalent worker)

OECD Industrial Category	Construction (Total)	Operation (Annual)
C11 Extraction of crude petroleum and natural gas and related services	0	549
C24X Chemicals excluding phamaceuticals	0	10
C28 Fabricated metal products, except machinery and equipment	183	0
C30T33 Electrical and optical equipment	478	21
C31 Electrical machinery and apparatus, n.e.c.	3,238	20
C40T41 ELECTRICITY, GAS AND WATER SUPPLY	0	5
C45 CONSTRUCTION	1,013	0
C50 Sale, maintenance and repair of motor vehicles and motorcycles - retail sale of automotive fuel	0	27
C60T63 Transport and storage	0	28
C60 Land transport - transport via pipelines	0	1,103
C65T74 FINANCE, INSURANCE, REAL ESTATE AND BUSINESS SERVICES	1,193	0
C65 Financial intermediation, except insurance and pension funding	550	0
C71 Renting of machinery and equipment	283	0
C72 Computer and related activities	0	19
MLTECH Medium-low technology manufactures	143	0
Sum	7,082	1,783