Economic Impact Analysis of CPV Towantic, LLC's Construction and Operation of an 805 MW Electricity Generation Facility in Oxford, CT

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EXECUTIVE SUMMARY

CPV Towantic, LLC (CPV) engaged the Connecticut Center for Economic Analysis (CCEA) to develop an analysis of the economic impacts that would flow from constructing and operating a natural gas-powered electric generating facility in Oxford, CT. CCEA used Regional Economic Model Inc.'s (REMI) model to project the impact that construction and operation of the facility will have on the State of Connecticut's economy, as well as that of local municipalities. This report presents CCEA's methodology and findings.

CCEA developed the analysis on the basis of CPV's construction estimates of inputs that could feasibly be purchased in Connecticut, as well as CPV's forecast of the facility's annual operating costs. Even where purchases are made in Connecticut the REMI model allocates supply-chain reactions either internally or externally to the state. Because of its sophistication, and ability to account for such interactions, the REMI model avoids exaggerating linked impacts within Connecticut during construction, ensuring CCEA's results are conservative.

This analysis assesses project impacts first for just construction of the facility, then for operations, and finally for the entire (total) project; that is, construction and operations combined. The results highlight the concentration of economic activity the project generates – both geographically (in the region of the state around Oxford, CT) and over time (aka, longitudinally). The economic impacts are particularly significant during the construction phase – approximately three years during which CPV anticipates spending nearly a quarter billion dollars in Connecticut. The CCEA's results also confirm that operations will deliver real economic benefits.

CCEA projects that from 2015 to 2040, CPV's project in Oxford will generate the following economic impacts for the State of Connecticut, its residents, and communities. The Towantic project will:

- Add over $7.85 billion in increased real state gross domestic product (RSGDP), in 2009-fixed dollars; about $7.9 billion in new household (personal) income, in current dollars;
- Deliver an average of 1,796 incremental jobs over-and-above the REMI base-case annually, or 46,706 job-years in total;
- Generate revenue to increase state's fiscal capacity by a total of $358 million, in 2009-dollars;
- Augment local governments' real state gross domestic product by $347 million, in 2009-dollars.

The economic benefits from CPV's project will benefit the entire state, but municipalities and constituents residing closer to Oxford will capture a greater share of the impacts.

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FORWARD-LOOKING STATEMENTS

This report contains forward-looking statements regarding economic and financial metrics. Herein, we do not use the term "forward-looking statements" as it is specifically understood within the Private Securities Litigation Reform Act of 1995. However, we use the term in a similar manner, in so far as forward-looking statements involve uncertainties because they relate to events, and depend on circumstances, that have yet to occur, but will or may happen in the future. Forward-looking statements are subject to risks and uncertainties, which could cause actual results to differ, possibly materially, from those anticipated and presented herein. Forward-looking statements are based on the authors' beliefs, established economic principles, and data from CPV and other accessible, reliable sources, as well as assumptions made by the authors and the base-case scenario contained in the REMI model.

When used herein, the words "forecast," "estimate," "anticipate," "should," variations of such words, and similar expressions, are intended to identify forward-looking statements. However, throughout this report, all economic impacts that have not yet been realized – that is, numbers that are not purely historical – as well as conclusions, recommendations, and the like that are based on such results, should be understood to be or involve forward-looking statements. Factors that could cause forward-looking statements to differ from actual results include but are not limited to: revisions to extant data series; alterations to federal, state, and municipal fiscal policies; timing of specific investments and/or expenditures; demographic growth; legal and regulatory developments; availability of new technologies; natural disasters, adverse weather conditions, and any other force majeure event.

All forward-looking statements made in this report are qualified by the cautionary statements in this section. The authors cannot guarantee that the results we anticipate (and present herein) will be realized, or even if realized, will have the expected consequences to, or effects on, the State of Connecticut's or local municipalities' economic situation. Forward-looking statements made in this report apply only as of the date of this report. While the authors may elect to update forward-looking statements, we specifically disclaim any obligation to do so after the date of this report.

INTRODUCTION

America's electric system – "the supreme engineering achievement of the 20th century," according to the National Academy of the Sciences – is aging, inefficient, and congested, and incapable of meeting the future energy needs of America's economy without changes and substantial capital investments over the next several decades.

As described in the EXECUTIVE SUMMARY, CPV engaged CCEA to develop an analysis of the economic impacts of constructing and operating a state-of-the-art 805 MW natural gas-powered electric generating facility in Oxford, CT. This report presents the results of that study.

Using data from CPV and other available, reliable sources, CCEA examined the construction and operation phases, as well the combined (aggregate) value of CPV's project, using the REMI model v.1.6.0. The REMI model allowed CCEA to project economic impacts to both the state and the region immediately surrounding Oxford for the period 2015 to 2040. This report presents results for specific indicators both longitudinally and as cumulative, discounted present (PV) values.

This report is organized into the following sections:

- **TERMS, DEFINITIONS, AND ACRONYMS**: Contains definitions and descriptions of key economic terms used, organizations referenced, and the meaning of certain phrases.
- **BACKGROUND AND SITUATION**: Provides an overview of the situation regarding the licensing and planned construction of an energy generating facility in Oxford, as well as some details regarding the CPV facility.
- **ECONOMIC IMPACT ANALYSIS**:
    - **CONSTRUCTION PHASE**: Describes the activities – and expenditures – expected to take place between 2015 and 2018, and resulting economic impacts that the modeling projects for this phase of the project.
    - **OPERATIONS PHASE**: Examines the economic impact of the facility's continuing operations from 2017 through 2040.
        - **SENSITIVITIES**: Provides additional information regarding how CCEA's findings could/would be impacted by changing assumptions regarding environmental impacts and/or modifications to RGGI payments.
    - **SUMMARY OF FINDINGS**: Amalgamates CCEA findings from the Construction and Operation Phases, summarizing total forecasted economic impacts from 2015 through 2040.
- **CONCLUSION**: Summarizes what CCEA believes are the salient findings of the study.

TERMS, DEFINITIONS, AND ACRONYMS

While every effort has been made to make the contents of this paper as accessible as possible, due to the nature of this study, references to certain (technical) economic concepts, as well as specific organizations, are necessary. This section presents definitions and descriptions of key terms used, organizations referenced, and the meaning of certain phrases.

ECONOMIC TERMS

- **Jobs**: "A job is defined as an uninterrupted period of work with a particular employer. Jobs are therefore employer based, not position-based. If a respondent indicates that he or she left a job but in a subsequent survey returned to the same job, it is counted as a new job."[i] Similarly if two employers each create a job the total number of jobs generated is two. Because many jobs are part time, the number of jobs in the economy exceeds the number of fulltime equivalent (FTE) employment. In this analysis, we consider three job classifications:
    - **Direct jobs** are those created by the organization or organizations responsible for generating an economic stimulus (e.g., construction jobs with a prime contractor, employees of a new business, etc.).
    - **Indirect jobs** are those created by the supply chain involved in delivering goods and services to the organization or organizations that generated the stimulus (e.g., jobs with secondary contractors, suppliers of materials, etc.).
    - **Induced jobs** are those created as the result of expenditures from direct, indirect, and other induced employees (e.g., jobs at restaurants, grocery stores, recreational tourism, etc.).
- **Job-years** are the number of annual jobs created by the project summed over each year.
- **Personal Income** is the sum of compensation to incremental employees plus proprietors' income plus current transfer receipts, minus government contributions for domestic social insurance.
    - **Disposable Personal Income**: Personal income less personal taxes. In other words, disposable personal income is what a household has discretion to spend after paying taxes on Personal Income.
- **Personal Current Taxes** includes income taxes paid directly to each order of government by households but excludes corporate taxes and sales taxes.[ii]
    - Of the $35.66 billion paid by Connecticut citizens in personal current taxes in 2013, $8.12 billion (22.8%) accrued to the state of which $7.93 billion was in personal income taxes, $183.6 million for motor vehicle licenses and $12.3

million other, mostly hunting, fishing and boating licenses. These shares among governments can vary over time. However, such shares are fairly stable assuming that federal and state income tax rates remain in the same proportion.

- **Present value (PV)** provides a way to aggregate the financial (and/or economic) impacts from different years into a single figure. PV takes into consideration the time value of money – the concept that, for various reasons (specifically individual utility and inflation), a dollar today is more valuable than a dollar in some future year. The mathematical expression of PV is:

$$PV = \sum_{t=0}^{N} \frac{Value_t}{(1+r)^t}$$

  Where *r* is the discount rate, *t* is the specific time period, and *N* is the total number of time periods. In (and throughout) this report, we use a discount rate of 5%;[iii] *t* is in years.

- **Real state gross domestic product (RSGDP)** is the total of the State's output adjusted to a common year, in this case 2009; "output" is the value added, not the value shipped, by each industry and sector of the economy.[iv]
  - When referring to RSGDP in this report, we use the term "**2009-fixed dollars**," sometime also referred to as "**2009-chained dollars**." According to the U.S. Federal Reserve Board: "The traditional way to define real GDP has been to sum the real year-*b* dollar expenditures for each category. The resulting series has the interpretation of 'the value of period *t*'s output had all prices remained at their year-*b* level.' Because this method values all quantities in terms of a fixed set of prices, as in a traditional Laspeyres index, it is known as a 'fixed-weight' measure of real output."[v] 2009 is used as the benchmark-year by both the U.S. Department of Commerce, Bureau of Economic Analysis (BEA)[vi] and REMI. To be consistent, herein, we use the same benchmark-year.
- **RGDP of State Government** is the annual real output generated by a state government.
- **RGDP of Local Governments** is the annual real output generated by local governments, e.g. municipalities. The figures presented in this report include all municipalities in Connecticut. However, the distribution of benefits will accrue disproportionately to those municipalities located in the immediate area surrounding the facility during both its construction and operations phases.

OTHER KEY TERMS

- The **Connecticut Siting Council** is the government agency most directly responsible for approving the construction of new power generation facilities in the State. Information regarding the Council, including its mission and jurisdiction, can be found at http://www.ct.gov/csc/cwp/view.asp?a=895&q=248310.
- The Connecticut **Department of Energy and Environmental Protection (DEEP)** "is charged with conserving, improving and protecting the natural resources and the environment of the state of Connecticut as well as making cheaper, cleaner and more reliable energy available for the people and businesses of the state." For additional information visit: http://www.ct.gov/deep/site/default.asp.
- "**The facility**" or "**the Towantic facility**" refers to the 805 MW gas-fired, 2x1 combined-cycle, electrical generation facility CPV is planning to construct on a 26-acre parcel of land due east of the northern end of the Waterbury-Oxford Airport in Oxford, CT. The Appendix in this report contains maps illustrating where the facility will be constructed. The specific location, according to the Connecticut Siting Council is, "… north of the Prokop Road and Towantic Hill Road intersection in the Town of Oxford, Connecticut."[vii]
- **Federal Energy Regulatory Commission (FERC)**: "The Federal Energy Regulatory Commission, or FERC, is an independent agency that regulates the interstate transmission of natural gas, oil, and electricity. FERC also regulates natural gas and hydropower projects." For additional information, visit: http://www.ferc.gov/about/about.asp; or, see FERC's *FY2014-FY2018 Strategic Plan*.[viii]
    - **FERC's Internal Market Monitor (IMM)** of Independent Systems Operator New England (ISO-NE) publishes an Annual Markets Report (AMR) that assesses the state of competition in the wholesale electricity markets operated by the ISO. The *2009 Annual Markets Report* covers the ISO's operating year, January 1 to December 31, 2009. The report addresses the development, operation, and performance of the wholesale electricity markets administered by the ISO and presents an assessment of each market based on market data, performance criteria, and independent studies. Monthly updates are available for subsequent periods to February 2012.[ix]
- **North American Industrial Classification System (NAICS)**: The U.S. Census Bureau maintains the North American Industry Classification System (NAICS) codes. For additional information on the codes, visit http://www.census.gov/eos/www/naics/.

- "**The project**" and "**CPV's project**" and "**the Towantic project**" refers to both the construction and operation of the facility, as well as all associated or related activities.
- **Regional Economic Model Inc.'s (REMI) model or "the REMI model"**: The REMI model is the primary tool CCEA uses for conducting long-term economic impact analyses. The REMI model is a multi-sector, dynamic, equilibrium impact model of Connecticut so that inputs and impacts are specific at the state level. The program measures total economic changes over time by comparing a baseline forecast (one in which there is no change) to an alternative scenario or scenarios via changing direct impacts generated by the company's project such as generation of direct industry jobs and development of new capital assets. Because the variables in the REMI system are inter-related, a change in any one variable affects many others. For example, if wages rise in one sector, the relative costs of producing a certain output (or outputs) change, and could potentially cause the producer to substitute capital for labor. The change in the capital-labor ratio potentially impacts input demands, which affect jobs, wages, migration and other variables throughout the economy. Such "chain-reactions" propagate across all sectors in the model over time. For additional information regarding the model, visit: http://www.remi.com/the-remi-model.
- **Regional Greenhouse Gas Initiative (RGGI)**: "RGGI is a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont to cap and reduce CO_2 emissions from the power sector." (http://www.rggi.org/) RGGI states implemented a new 2014 cap of 91 million short tons. The cap then declines 2.5 percent each year from 2015 to 2020. Regulated power generation facilities can use a CO_2 allowance issued by any participating state to demonstrate compliance with an individual state program. In this manner, the state programs, in aggregate, function as a single regional compliance market for CO_2 emissions.
- **U.S. Energy Information Administration (EIA)**: "The U.S. Energy Information Administration (EIA) collects, analyzes, and disseminates independent and impartial energy information to promote sound policymaking, efficient markets, and public understanding of energy and its interaction with the economy and the environment." For additional information, visit: http://www.eia.gov/about/.

BACKGROUND AND SITUATION

In 1999, the Connecticut Siting Council issued a Certificate of Environmental Compatibility and Public Need approving construction of a 512 MW power generation facility in Oxford. Construction of the electric generation facility has been in continuous discussion since that date, owing, in large part, to the bankruptcy of the original developer, Towantic Energy L.L.C. (Towantic Energy), a subsidiary of Arena Capitol Ltd.

On January 4, 2007, the Connecticut Siting Council re-visited the issue; it resolved that, since 1999, "the stated changed conditions, as outlined in the Council's hearing notice, alone or cumulatively, are not sufficient to modify or otherwise reverse the Council's 1999 final decision granting the Certificate. The Council will not conduct further proceedings to consider modifying or reversing its 1999 final decision at this time."[x]

Since assuming responsibility for this project, CPV has upgraded previous (existing) designs of the 512 MW facility, expanding production potential to 805 MW. The illustration below is a rendering of the current design.

Source: CPV Towantic Energy Center Fact Sheet[xi]

For CCEA's analysis, two changes CPV has made to previous plans are especially important:

1) Expanding generating capacity of the facility from 512 MW to 805 MW; and
2) Redesigning the facility to incorporate newer, more efficient technologies, which generate electricity with significantly lower noise and with fewer emissions per KW than older (and many existing) facilities.

Because operations of the grid distribution system are beyond CPV's control, CCEA is unable to project the potential impact of the enhanced generation capacity on regional retail electricity markets; they are therefore excluded from this report.[1] Yet ISO New England's *2009 Annual Market Analysis Report* notes, "Connecticut has insufficient reserve capacity to meet the zonal reserve requirements. Consequently, the Connecticut and (Southwest Connecticut) SWCT reserve zones have cleared at the price cap of $14.00/kW-month in each reserve auction."[xii] In addition, due to supply constraints, Southeast Massachusetts and Southwest Connecticut had the highest average day-ahead prices.[xiii] It is important to be alert to both issues, issues that provide a critical framework when considering this report's findings and conclusions.

The expansion of generating capacity– from 512 MW to 805 MW – is important because it impacts the amount (or quantity) of electricity available in Connecticut. The Towantic facility will sell power into the grid; that is, it will be a *wholesale provider* of electricity. As such, CPV's ability to set, or control, either where electricity is directed or how much it costs (per kWh) when it reaches consumers – the *retail price* – is limited. As a result, this report is neither based on, nor provides, specific rates beyond those embedded in the REMI model. However, the presence of a generating facility in Oxford should, *ceteris paribus*, (i) increase reliability for consumers (individuals and businesses) located in the immediate area, and (ii) exert downward pressure on rates (as a consequence of helping to augment the supply of electricity as demand increases and other smaller antiquated generating facilities within and outside of Connecticut go off-line).

The availability of affordable, reliable electricity is particularly germane here, because of the strong relationship between energy and economic performance. While the exact (quantitative) relationship is a topic of much debate among academics, industrial experts, policy makers, the general relationship is clear: Reliable, affordable electricity is a necessary condition for economic growth.[xiv]

[1] These factors have not been included in the calculations for practical reasons (availability and reliability of long-term forecast figures), as well as to help ensure that CCEA's results are conservative. Making assumptions about future rate moves could upwardly bias our forecasts. It is CCEA's intention, whenever possible, to assume a conservative posture with regard to calculations, and only comment in the text about additional benefits that could (or, will likely) occur.

Based on information provided by CPV, as well as independent research, CCEA understands that the use of combined-cycle and other advanced technologies – such as new, more efficient turbines and state-of-the-art emission controls – will result in greater efficiency in generating electricity, which in turn minimizes emissions of CO_{2eq} and particulates per MWH relative to generators currently in use, regardless of fuel type.[xv]

The innovative technologies the Towantic facility will utilize in generation are particularly important. Currently, Connecticut internally uses fossil fuels, nuclear and, to a limited extent, small hydro generators and renewables as primary fuels[xvi] for electricity generation while purchasing the remainder on the grid; that power comes mainly from aging fossil-fuel facilities. ISO-New England has identified significant electric generation – more than 4,000 MW of capacity – at risk of retirement by 2020.[xvii] Absent replacement capacity, such as that Towantic will provide, would translate into a major crisis for the region.

Total MW Retiring in New England*	
Connecticut	528 MW
Maine	159 MW
Massachusetts	2,682 MW
New Hampshire	56 MW
Rhode Island	64 MW
Vermont	666 MW
Total	**4,155 MW**

*Megawatts based on relevant Forward Capacity Auction (FCA) summer qualified capacity (NOTE: total includes full and partial generator and demand response Non-Price Retirement (NPR) requests for Capacity Commitment Period (CCP) 2013-2014 through CCP 2017-2018)

During peak summer months of July and August in 2014, Connecticut generation reached 6,506 GWH, of which the primary fuels were natural gas (3,155 GWH), nuclear (3,001 GWH), Biomass (126 GWH), Conventional Hydro (52 GWH), coal (49 GWH), petroleum liquids (15 GWH), pumped storage (1 GWH) and other (107 GWH).[xviii] For the same two months, New England generated 21,525 GWH, for which the primary fuels were gas (11,345 GWH), nuclear (6,680 GWH), Biomass (1,346 GWH), Conventional Hydro (1,223 GWH), petroleum liquids (69 GWH), coal (288 MWH), other renewables (313 GHW), pumped storage for peak generation (83 GWH), and other (345 GWH).[xix]

As older, less-efficient facilities are shuttered, both their electrical output and emissions will cease; the pace of that transition will depend on future growth in demand for electricity and the rate at which new generation comes on-line. The current upswing in manufacturing recovery will, among other factors, drive growth in electricity demand amidst uncertainties about when new generating capacity will come on-line may postpone retirement of antiquated pollution-intensive generating facilities despite minimal use.

A full quantitative analysis of the economic impacts from different generating facilities going off-line is beyond the scope of this report, particularly as other factors would come into play – weather patterns, for instance. Such factors lie outside of CPV's control. However, the report returns later to the issue of environmental impacts in the SENSITIVITIES sub-section.

ECONOMIC IMPACT ANALYSIS

This economic impact analysis assesses differences in key Connecticut economic indicators of constructing and operating the Towantic facility in the state.

The inputs are for those CPV expects to purchase in Connecticut, not for the totality of the project. Constraining the impact analysis in this fashion ensures that the Connecticut-based material inputs for the project are not exaggerated. The process utilizes CCEA's latest REMI outlook as the base case which is 'shocked' by the construction and operation of the new facility.

In undertaking this analysis, CCEA has relied on CPV to supply data regarding anticipated construction expenditures. Such numbers are subject to change as engineering estimates become more refined. However, CPV completed construction of a similar facility in 2012 and currently has two more comparable facilities under construction in New Jersey and Maryland. As such, CCEA has a high degree of confidence in CPV's estimates for the Towantic project.

Future refinements will most likely have an impact on industry specifics, which could influence the results presented herein either positively or negatively, depending on the labor and capital intensity of alternatively impacted industries and their supply-chains within the state. Aside for any actual quantities of electricity generated, such changes are more apt to influence impacts during the brief construction period rather than during longer-term operations.

CPV anticipates the Towantic facility will begin operations in 2018. To capture a complete, comprehensive forecast of the economic impacts the facility will deliver, CCEA calculated the economic impact of the construction and operations phases independently – results shown below in the CONSTRUCTION PHASE and OPERATIONS PHASE sub-sections, respectively – and then analyzed the entire project. CCEA's findings regarding the impact of the entire project are presented in the SUMMARY OF FINDINGS sub-section.

CONSTRUCTION PHASE

Table 1 shows expected Connecticut project construction expenditures. It includes everything but land purchases.[2]

Table 1
Expected Construction Expenditures Likely in Connecticut (2015-2018, in Millions of Dollars)

Expenditures	2015	2016	2017	2018
Labor	$75,000	$1,125	$33,990	$37,530
Materials	$16,164	$242	$7,325	$8,088
Specialty Subcontracts	$6,256	$94	$2,835	$3,131
Heavy Equipment Rental	$1,000	$15	$453	$500
Site Support Subcontracts	$750	$11	$340	$375
Local Road Construction	$4,000	$667	$3,333	$0
Electrical Interconnect	$76,350	$1,145	$34,602	$38,206
Land Purchase	$500	$500	$0	$0
Property Taxes During Construction	$12,075	$6,200	$2,350	$2,350
Sales Tax	$22,183	$333	$10,053	$11,100
Initial Fills (99% Oil, 1% Water)	$8,250	$0	$0	$0
Gauge Station O&M	$50	$0	$25	$25
IFIM Study	$350	$0	$0	$0
Totals	**$222,928**	**$10,332**	**$95,307**	**$101,306**

The industrial breakouts in Table 1 do not align perfectly with the NAICS codes on which REMI relies to project economic impacts. Below, we outline how CCEA matched CPV's expenditures with NAICS codes:

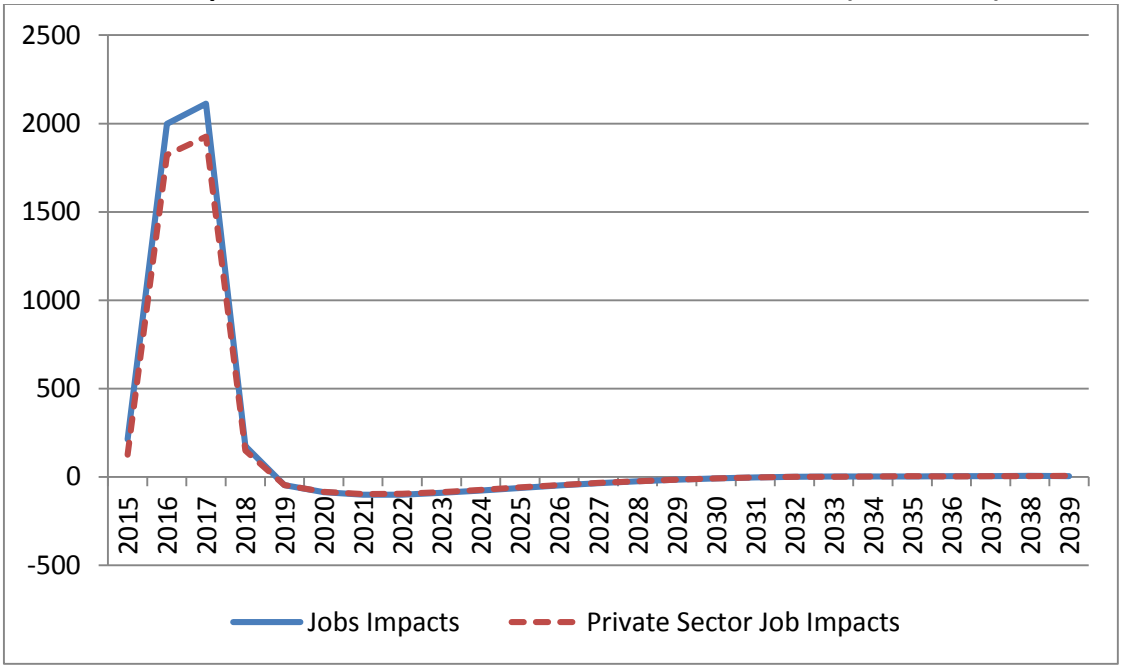
- Labor expenditures and those in specialty contracts have been treated as non-residential construction in Connecticut.
- The electrical network costs are split roughly 50-50 between non-residential construction and intellectual property (IP) investments.
- The water gauge station activities and the IFIM study were treated as professional, scientific and technical services.
- Site Support subcontracts were included in REMI as non-residential construction.
- The road was treated as direct construction.
- In keeping with balanced budgets various funds garnered by governments are assumed to be spent by them (in the same proportion as current budget expenditures).
- The materials are broken out among: ready-mix cement (20%); power boilers and heat exchangers (20%); fabricated pipe and primary pipe fitting equipment (20%); and, other industrial machinery and equipment (40%).
- In-fills of oil and water were treated as purchases from the petroleum products industry (99%) and utilities (1.0%). At other sites, oil is held as a reserve and is not utilized. The Towantic facility is expected to operate in a similar fashion.

[2] Land transfers are omitted from economic impact analyses because such they do not add to fixed resources.

Chart 1 shows derived job impacts from the construction phase. Job creation peaks in 2017 at 2,112, but declines quickly following end of construction, followed by a prolonged recovery out to 2032. Out to 2040, the project generates 3,830 job-years, most during construction. The vast majority of the construction job-year impacts are in the private sector (3,382). The differences between total employment and private employment are public sector job impacts, also concentrated in the construction phase.

Construction activity tends to attract people to the region or retain them during construction only to be followed by prolonged adjustments thereafter.[3] Operations can – as the OPERATIONS PHASE and SUMMARY OF FINDINGS sections of this report address – more than offset those adjustments, yielding significant sustained impacts in the area, both annually and on a cumulative basis. More specifically, as indicated in Chart 2, the construction phase (excluding operations) will result in an average of negative fifty jobs per year beginning in 2019 and ending in 2032. However, if we include activities resulting from the facility's operations, during that same period, the average annual job benefits are 1,728, of which 1,359 are in the private sector.

Chart 1
Job Impacts of the Construction Phase on Connecticut (2015-2040)



[3] For modeling purposes, in the construction phase, we assume that the facility is built but does not operate; that is, after being built, the facility sits idle. Such a situation/assumption is clearly erroneous in this circumstance, as the Towantic facility is expected to commence operations immediately following completion of construction. As such, the job losses (aka, adjustments) shown in Chart 1 are only one part of the overall picture.

Table 2 illustrates the same pattern of peak and total impacts in key metrics. Measured by any of these key growth indicators, 50% (±10%) of the net positive impacts over 25 years are concentrated in the peak years of construction.

Table 2
Non-Job Impacts of the Construction Phase on Connecticut (2015-2018)

Impact Indicators	Units of Measure	Peak Impacts 2017	Total Impacts
Real Gross Domestic Product	Millions of 2009-Fixed Dollars	$156	$272
Personal Income	Millions of Current Dollars	$146	$307
Disposable Personal Income	Millions of Current Dollars	$113	$245
Personal Taxes (includes adjustment for inflation)	Millions of Current Dollars	$33	$63
RGDP of State Government	Millions of Fixed (2009) Dollars	$6.5	$12.8
RGDP of Local Governments	Millions of Fixed (2009) Dollars	$6.8	$19.1

OPERATIONS PHASE

The analysis of operations flows from bringing the inputs that are required to operate the new generating facility into the model. Due to differences in primary fuels, this approach necessarily replaces the assumption embedded in Input-Output analysis that the new facility will operate with the average inputs of the current generating system within Connecticut. That approach would ignore the primary energy source for the new facility is natural gas, rather than the (proportionately) current large share of Connecticut electricity generation from nuclear power (47%).[xx]

Table 3 presents the expected operating expenditures – those used as inputs in the REMI model. Fuel expenditures for natural gas dominate. CCEA modeled fuel consumption specifically as an increase in the demand for natural gas. RGGI is modeled as a payment under cap-and-trade for CO_{2eq} and is included with DEEP fees and sales taxes as revenues accruing to the state. Operating labor enters the model in the form of expenditures for 24 employees required to manage Towantic on an annual basis. The REMI model builds industrial average wages, salaries and fringe benefits into its projection.[4]

[4] Because construction of the facility is already part of the model and other inputs were also specified investments to match both employment and other inputs that the model would otherwise have called forth to match the labor inputs were nullified. Similarly for those industries using infrastructure built as part of the project any further

Table 3
Expected Operating Costs Likely in Connecticut (2018-2023, in Thousands of Dollars)

Input	2018	2019	2020	2021	2022	2023
Fuel (natural gas)	$113,990	$225,031	$236,809	$244,150	$251,909	$263,202
RGGI	$6,169	$11,496	$11,614	$11,831	$11,804	$11,939
Labor (including fringe benefits)	$2,112	$3,711	$3,804	$3,899	$3,996	$4,096
Materials & Supplies	$496	$871	$893	$915	$938	$962
Contract Services	$350	$615	$630	$646	$662	$679
Auxiliary Power (CL&P)	$117	$205	$210	$215	$221	$226
Community Support	$50	$50	$50	$50	$50	$50
Electric Interconnect O&M	$2,280	$4,006	$4,106	$4,209	$4,314	$4,422
CT DEEP Annual Emissions Fee	$25	$44	$45	$46	$47	$48
Chemicals and Consumables	$1,416	$2,504	$2,621	$2,668	$2,690	$2,749
Water Supply	$49	$85	$90	$91	$92	$94
Gauge Station O&M	$25	$25	$0	$0	$0	$0
Wastewater Discharge	$11	$18	$19	$20	$20	$20
Sales Tax	$28	$49	$52	$77	$53	$54
BOP Maintenance	$1,647	$1,647	$1,647	$1,647	$1,647	$1,647
Property Tax	$2,800	$2,800	$2,800	$2,800	$2,800	$2,800
Totals	**$131,564**	**$253,157**	**$265,389**	**$273,264**	**$281,243**	**$292,988**

Operating materials and supplies were divided up among five industries in the REMI model: Light vehicle and utility truck manufacturing (40%); Administrative support (22.5%); Industrial gases (20%); Power driven hand tools (10%); and, Repair and Maintenance (7.5%).

Operating contract services have been divided among: Administrative services (60%); Waste management (25%); and, Computer and peripheral services (15%).

Chemicals were classified as inorganic; property taxes were treated as flowing to the local government. Direct operating costs beyond 2023 are projected to grow at the annual rates from 2018[5] to 2023.

construction called forth by normal economic linkages has been thwarted. CCEA compared the results to those obtained by entering incremental wages and salaries and found that the results were comparable.

[5] 2017 is a start-up year; the Towantic facility will operate only part of the year so it is excluded from projections to help ensure that results are conservative.

SENSITIVITIES

Because operation of the grid, including the generators for which the new facility may operate as a substitute, and some of the offsets to its RGGI payments and their emissions are beyond the capabilities of CPV to control, CCEA based its calculations on a scenario in which all generation displaced by the new facility is currently imported into Connecticut and the plume from the new facility does not fall outside Connecticut.

CCEA has run a sensitivity case where all the fallout from the new facility dissipates over Connecticut. The results of that sensitivity case indicate that cumulated job-year impacts would be reduced by approximately 2% of the estimates shown in the above results.

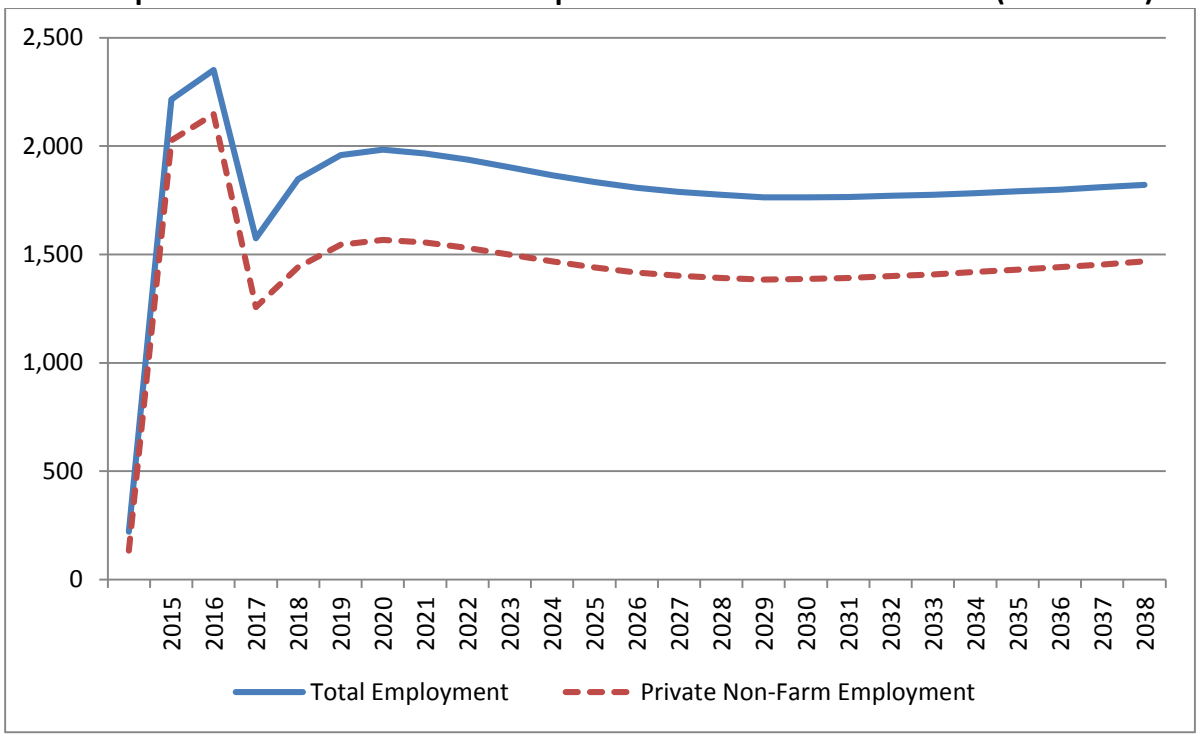
Should the new facility's output replace power currently generated in Connecticut from fossil fuels, the impacts could shrink due to offsetting labor costs and shrinking RGGI payments to the state government from those alternative generating facilities. Simultaneously the adverse impacts on amenities from the emissions fallout would be decreased. In the case of relatively inefficient coal generation, the adverse impacts from emission fallout would extend beyond savings of CO_{2eq} to impacts of particulate matter linked to health issues. However, as noted earlier, even during peak operations Connecticut utilized little coal or petroleum generation in 2014, though New England's operating shares of such facilities were marginally higher.

SUMMARY OF FINDINGS

The combined impacts on jobs of the entire project – both the construction phase and operations phase –are significant, as Chart 2 reveals.[6] The immediate post construction job losses are soon reversed as annual operating direct, indirect, and induced jobs recover to about three-quarters of those achieved during peak construction.

[6] CCEA's overall findings are consistent with the analysis Michigan State University developed to evaluate the benefits that would flow to that state's economy switching generation from coal to gas. See: William Knudsen. (2011). The Economic Impact of Replacing Coal with Natural Gas for Electricity Production, *The Strategic Marking Institute, Michigan State University*, Working Paper 01-0811.

Chart 2
Job Impacts of the Construction and Operations Phases on Connecticut (2015-2040)



Construction job impacts peak in 2017 at 2,351; operational ones in 2021 at 2,148, after which total jobs are sustained above 1,763. Of these jobs, most are in the private sector, sustained at or above 1,384 annually. Over the 25 years, the project is expected to generate or save 46,706 job-years, of which 37,500 are in the private sector.

Among the most heavily impacted sectors are those where personal consumption expenditures and residential investments impact growth. For example by 2021, industries generating the most jobs are:

- Construction = 693;
- Utilities = 208;
- Retail = 160;
- Professional, scientific and technical services = 128; and
- Healthcare and social assistance = 98.

The construction job estimates during operations are minimal because every model link from industries using previously built infrastructure, other than for repair and maintenance, has been turned off. Included in construction are repair and maintenance at the facility as well as indirect and induced construction impacts resulting from the larger economy involved in

accommodating the larger population and its demands. Additional indicators, measured in constant dollars, generally follow patterns similar to employment. Table 4 below presents the results. Current dollar values escalate over time with underlying inflation.

Table 4
Non-Job Impacts of the Construction and Operations Phases on Connecticut (2015-2040)

Impact Indicators	Units of Measure	Peak Construction Impacts (2017)	Peak Operating Impacts (Peaking in)	Total Impacts
Real Gross Domestic Product	Millions of 2009-Fixed Dollars	$156	$395 (2039)	$7,853
Personal Income	Millions of Current Dollars	$146	$457 (2039)	$7,918
Disposable Personal Income	Millions of Current Dollars	$113	$363 (2039)	$5,690
Personal Taxes (includes adjustment for inflation)	Millions of Current Dollars	$33	$96 (2039)	$1,228
RGDP of State Government	Millions of Fixed (2009) Dollars	$6.5	$16.0 (2021)	$358
RGDP of Local Governments	Millions of Fixed (2009) Dollars	$6.8	$15.0 (2023)	$347

Different from job impacts, post construction annual peak impacts with these other metrics exceed those for the entire construction phase, with the exception of RSGDP of local governments. Even though its peak year does not exceed total construction impacts, peak local RSGDP impacts in operations still more than doubles its peak year construction impacts.

In addition to the state impacts driven by spending funds flowing from the project to the state, it also receives a share of the personal income taxes that do not appear to be linked in REMI; these would further swell state revenues with which to address its priorities. Incremental personal income taxes accruing to the federal and state governments increase by $1.23 billion, due to increased economic activity.

Due to the underlying model dynamics, real RGDP peaks in a different year than for state government RGDP because productivity increases play a more significant role in the private sector rather than the public. Because of projected mild underlying inflation, measures valued in current dollars peak at the end of the simulation and would continue to grow thereafter.

CONCLUSION

Utilizing state-of-the-art technologies to generate electricity efficiently, the Towantic facility addresses a pressing need in the State of Connecticut, as well as the entire New England region.

CCEA's focus in conducting this study was to examine the economic impact that construction and operation of the Towantic facility will deliver at the state and local levels. As seen in the results presented in this report, these impacts are not only positive, but also considerable in terms of the economic benefits to the state and its residents, as well as the communities and municipalities immediately surrounding Oxford, CT.

Both during construction and operation of the facility, the Connecticut economy and, most importantly, the households/individuals who live in the state – primarily those who reside in the immediate area surrounding the facility's location – will benefit materially. CPV's project will lead to:

- Job creation – a peak employment in the construction phase of more than 2,300 positions, with sustained jobs approaching 1,800. This is an increase of approximately 0.1% of Connecticut's total employment during the construction phase and roughly 0.1% increase during the operation phase;
- Enhanced state and municipal revenues – by 2040, total income taxes increase by close to one and a quarter billion dollars (without increasing the tax rate, but simply as the result of greater personal income for Connecticut's residents);
- Greater reliability and quantity of electricity capacity, which should exert downward pressure on rates (as a consequence of helping to augment the supply of electricity as both demand increases and other smaller, antiquated generating facilities within and outside of Connecticut go off-line); and
- Billions of dollars in additional personal income for Connecticut's residents ($7.92 billion, in current-dollars) and increased RSGDP ($7.85 billion, in 2009-fixed dollars).

In addition to the results presented in this report, the Towantic facility is the type of infrastructure improvement that Connecticut desperately needs to attract businesses, grow its workforce, and expand its economy. While these benefits are not included in the quantitative results presented herein – in part because they are somewhat speculative, and in part to ensure findings are conservative – such benefits are both real and vital to Connecticut's economic vitality and competitiveness.

APPENDIX 1 – ABOUT CCEA

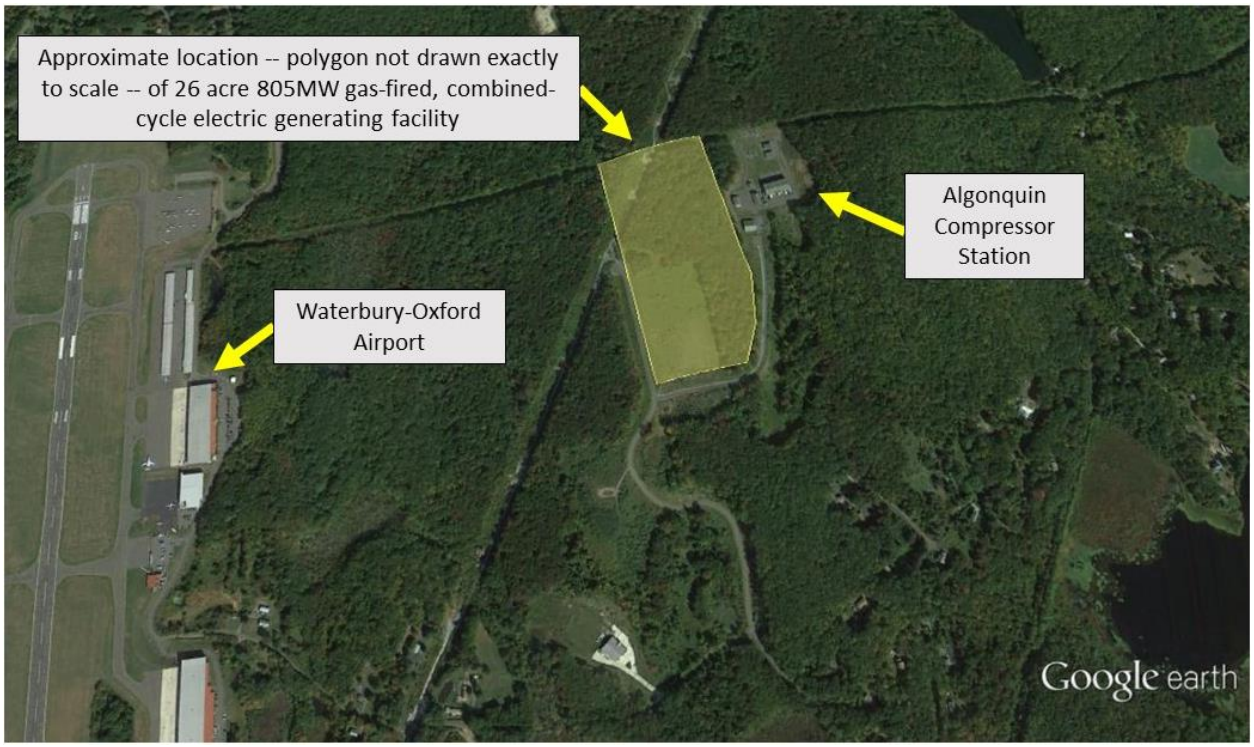
The Connecticut Center for Economic Analysis (CCEA) is a University Center located within the School of Business at the University of Connecticut (UCONN).

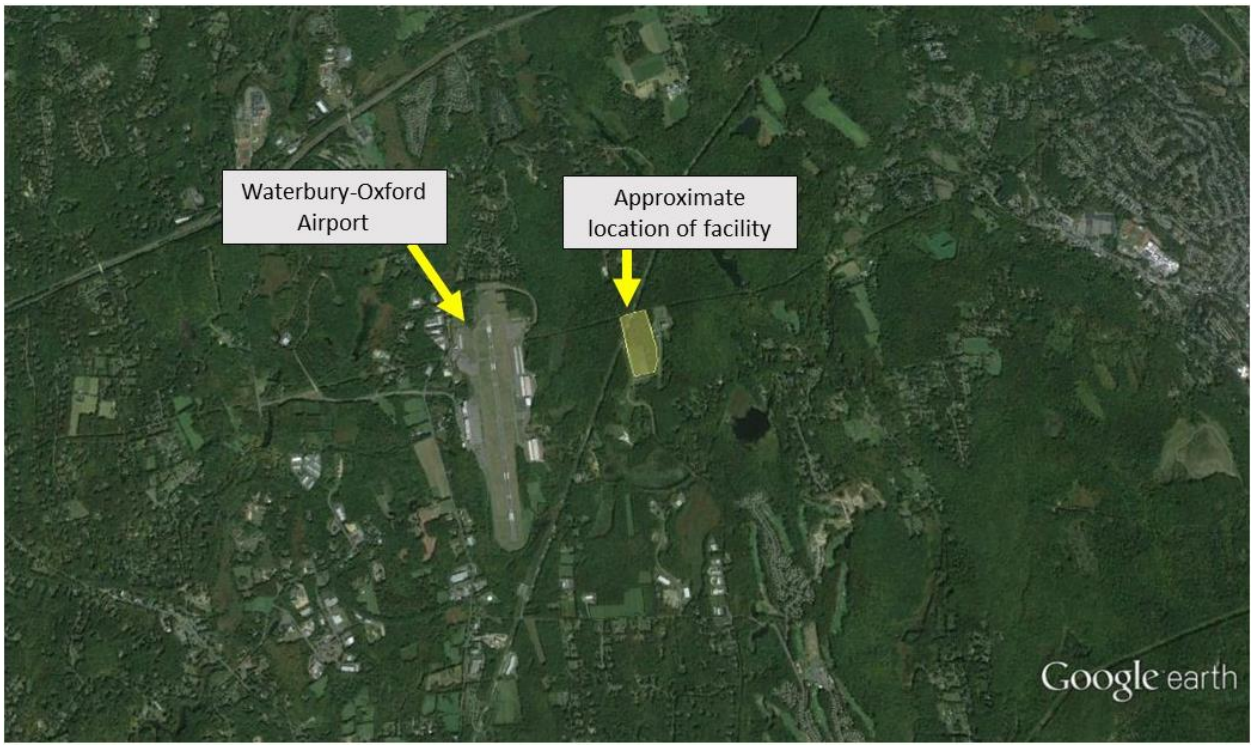
CCEA specializes in economic impact and policy analysis studies as well as advising clients regarding business strategy, market analysis, and related topics. CCEA focuses particular attention on the economic and business dynamics of Connecticut, for which it maintains a license to the dynamic REMI model of the state's economy.

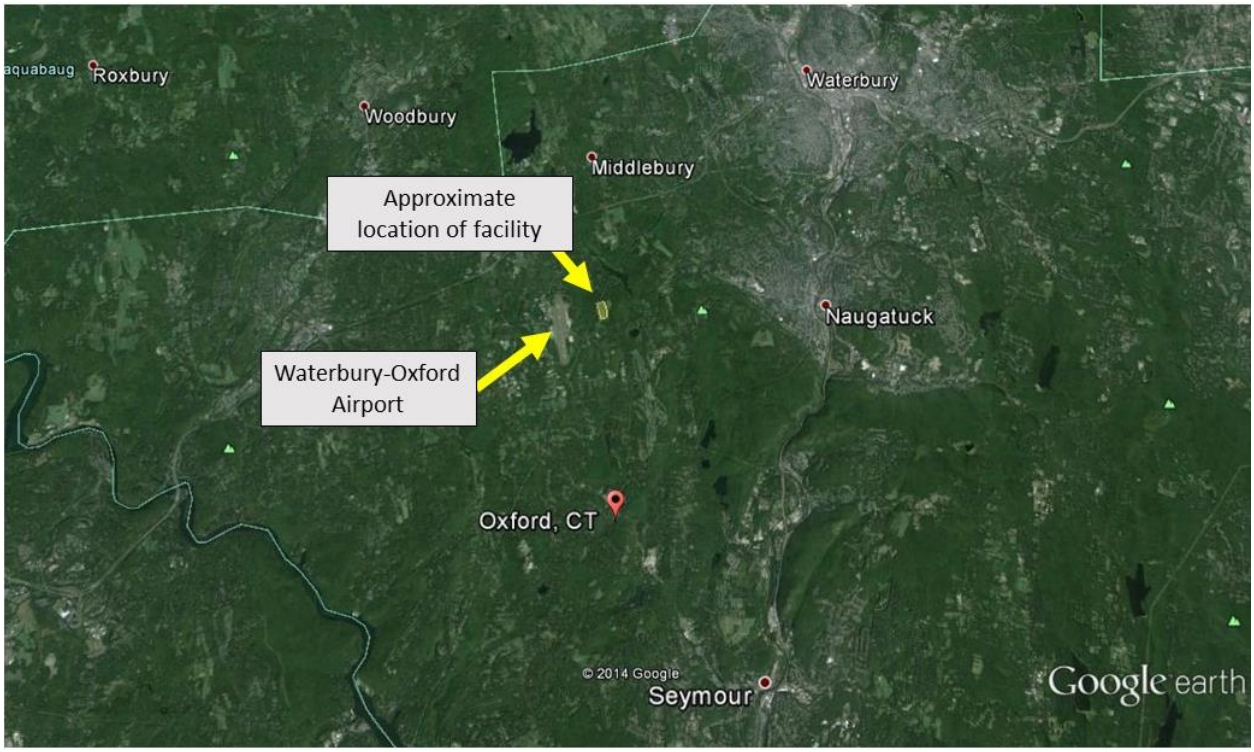
CCEA was created at the request of Governor Weicker in 1992 to serve the state's citizens by providing timely and reliable information regarding Connecticut's economy and to evaluate the potential impacts of proposed policies and strategic investments. By mobilizing and directing the expertise available at the UCONN, state agencies, and the private sector, CCEA aims to equip the public and decision makers with transparent analyses to facilitate systematic, thoughtful debate of public policy issues.

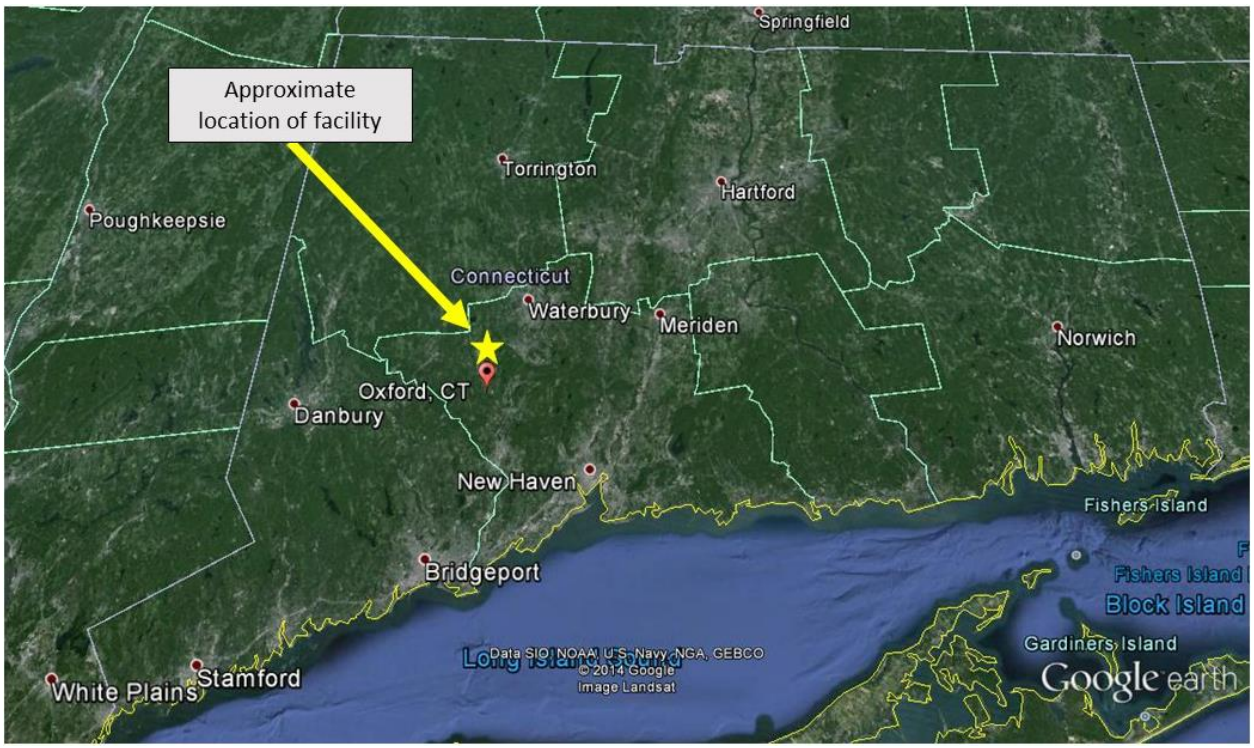
CCEA has conducted hundreds of studies involving the Connecticut economy, at both the state and local levels. Copies of its studies and reports that are available to the general public, can be found at http://ccea.uconn.edu/. For additional information about CCEA, please contact Professor Fred Carstensen (860.305.8299, fred.carstensen@uconn.edu).

APPENDIX 2 – MAPS






Roxbury
Woodbury
Waterbury
Middlebury
Approximate location of facility
Naugatuck
Waterbury-Oxford Airport
Oxford, CT
© 2014 Google
Seymour
Google earth


Springfield
Approximate location of facility
Torrington
Hartford
Poughkeepsie
Connecticut
Waterbury
Meriden
Norwich
Oxford, CT
Danbury
New Haven
Fishers Island
Bridgeport
Block Island
Gardiners Island
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2014 Google
Image Landsat
White Plains
Stamford
Google earth

ENDNOTES

[i] U.S. Department of Labor, Bureau of Labor Statistics (BLS): "Number of Jobs Held, Labor Market Activity, and Earnings Growth among the Youngest Baby Boomers: Results from a Longitudinal Study." http://www.bls.gov/news.release/pdf/nlsoy.pdf.

[ii] BEA, National Accounts. In assessing impacts dynamically, the difference between personal income and personal disposable incomes can also be impacted by adjustments to the economy for inflation. http://www.bea.gov/iTable/iTable.cfm?ReqID=9&step=1#reqid=9&step=3&isuri=1&903=58

[iii] For additional information on the subject of using discount rates in economic impact analysis studies, see, among others: Bellinger, W. K. (2007). *The Economic Analysis of Public Policy*, London and New York.

[iv] The U.S. Department of Commerce, Bureau of Economic Analysis (BEA), updates the National Income and Product Accounts (NIPA) throughout the year, as well as annually. (In fact, values can be updated for years after they were originally published.) Since the NIPA figures are used to calculate a variety of metrics, such as GDP, these revisions can (and frequently do) change values that are used to model economic performance that occurred in the past (aka, "extant data series"); that is, values can/could be thought of as being "historic." For additional information on this topic, see the "Estimate 'vintages'" section of the BEA's *Primer on GDP and the National Income and Product Accounts* (http://www.bea.gov/national/pdf/nipa_primer.pdf).

[v] Whelan, Karl. (2000). A Guide to the Use of Chain Aggregated NIPA Data, *Division of Research and Statistics, Federal Reserve Board*, http://www.federalreserve.gov/pubs/feds/2000/200035/200035pap.pdf.
"A Laspeyres price index is computed by taking the ratio of the total cost of purchasing a specified group of commodities at current prices to the cost of that same group at base-period prices and multiplying by 100. The base-period index number is thus 100, and periods with higher price levels have index numbers greater than 100." (http://www.britannica.com/EBchecked/topic/331007/Laspeyres-index)

[vi] http://www.bea.gov/

[vii] http://www.ct.gov/csc/cwp/view.asp?a=962&Q=556110&PM=1

[viii] http://www.ferc.gov/about/strat-docs/strat-plan.asp

[ix] http://www.ferc.gov/market-oversight/mkt-electric/new-england/isone-archives.asp

[x] http://www.ct.gov/csc/cwp/view.asp?a=958&q=330596

[xi] http://www.cpvtowantic.com/pdfs/towantic.factsheet_august%202014.pdf

[xii] http://www.iso-ne.com/markets/mktmonmit/rpts/other/amr09_final_051810.pdf

[xiii] Ibid.

[xiv] Many academic studies (as well as industry analyses, and research by other groups) has been done on the relationship between energy/electricity and economic performance. Below are a very few select references that address the relationship between economic performance and energy/power availability, cost, and reliability:

- Ayres, Robert and Benjamin Warr. (2010). *The Economic Growth Engine: How Energy and Work Drive Material Prosperity*, Edward Elgar Publishing, ISBN-13: 978-1849804356.
- Carley, Sanya, Sara Lawrence, Adrienne Brown, Andrew Nourafshan, and Elinor Benami. (2011). Energy-Based Economic Development, *Renewable and Sustainable Energy Reviews*, Vol. 15, Issue 1, pp. 282-295.
- Foster, John. (2014). Energy, Knowledge and Economic Growth, *Journal of Evolutionary Economics*, Vol. 24, Issue 2, pp. 209-238.
- Stiglitz, Joseph. (1974). Growth with Exhaustible Natural Resources: Efficient and Optimal Growth Paths, *The Review of Economic Studies*, Vol. 41, Symposium on the Economics of Exhaustible Resources, pp. 123-137.

[xv] "… the [natural] gas-to-electricity process inherently generates less CO_2 per MW than from coal… For example, the current California Emission Performance Standard sets the limit for CO_2 emissions at 500 g kW^{-1} h^{-1} of electricity, equal to that of the average natural gas combined-cycle (NGCC) plant or *about half of the amount produced by coal*." [emphasis added] (Thomas A. Adams II and Paul I. Barton. (2010). High-Efficiency Power Production from Natural Gas with Carbon Capture, *Journal of Power Sources*, Vol. 195, Issue 7, pp. 1971-1983.)

[xvi] http://www.eia.gov/state/maps.cfm?v=Electricity

[xvii] "ISO estimates up to 8,300 MW of non-gas-fired generation is 'at risk' for retirement by 2020 (28 older oil and coal units)." http://www.ferc.gov/CalendarFiles/20140610083119-Brandien,%20ISO%20New%20England.pdf. The chart – "Total MW Retiring in New England" – included in this analysis is taken from FERC paper cited here.

[xviii] http://www.eia.gov/electricity/data/browser/

[xix] http://www.eia.gov/electricity/data/browser/

[xx] CASEnergy Coalition (http://casenergy.org/nuclear-basics/energy-in-your-state/connecticut/). Please note: The earlier generation figures were for peak summer months – specifically, the figures earlier this report, that refer to the months of July and August in 2014 – whereas the 47% figure is annual.