Comments of The United Illuminating Company
December 21, 2012

Docket F-2012/2021
Draft Report
December 14, 2012

INTRODUCTION

Connecticut's electric system provides service to approximately 3.5 million residents and approximately 78 thousand businesses and impacts our lives in many ways. The system's infrastructure includes 110 generating units whose ~~output~~electrical energy is dispatched onto the regional supply network—over 1,800 circuit-miles of high-voltage conductors that form the transmission grid, and more than 130 substations that ~~finally~~ direct electricity to individual users via the distribution system.

This network of electric connections must be highly reliable, reflecting its importance not only for our State, but for our region. Reliability is a special challenge, given current global circumstances, ~~with its~~ volatile fuel prices, new energy technologies, and climate change concerns. Daily operations of the grid, including both power flows and transactions within the wholesale market for electricity, are managed by the Independent Systems Operator for New England~~,~~. ISO New England Inc. (ISO-NE) is a private, not-for-profit corporation, governed by an independent board of directors and overseen by the Federal Energy Regulatory Commission (FERC). Reliability standards set or approved by FERC are carried out through ISO-NE by its member companies. This centralized regional authority for management helps to ensure that the system functions reliably and efficiently. ~~With the same aim,~~ ISO-NE also directs annual forward planning for electric transmission needs in our region. The main participants in ~~the~~ this regional planning process are ~~regional ones:~~ generators, suppliers (including suppliers of renewable resources), transmission owners, publicly-owned utilities, and end users. Nonetheless, since each state regulates the power facilities in-state only, and affects future electric reliability by establishing energy policies and for in-state businesses and citizens, the prudent state must carefully review forecasts of anticipated electric supply and demand within its own borders.

Since 1972, the Connecticut General Assembly has mandated the Connecticut Siting Council (Council) to provide an annual review of our State's electricity needs and resources, looking ahead ten years. As is to be expected, the utility companies themselves provide projections. Most of Connecticut's electric system data is used in common by all the State and regional planners and is supplied by Connecticut generators and by our State's two largest transmission and distribution companies, The Connecticut Light and Power Company (CL&P) and The United Illuminating Company (UI), as well as by the Connecticut Municipal Electric Energy Cooperative (CMEEC). These data have been developed for their own corporate planning. Other planning groups model these data to emphasize fuel characteristics, cost issues, efficiency, and so forth. As more and more forecasting has been undertaken by different parties to make sure, in different ways, that the electric system will remain reliable, the more the Council has tried, in its annual forecast review, to emphasize openness, to clarify differences in approach, and to assess consistency.

CL&P and UI were mandated by the Public Act 07-242 to create an Integrated Resource Plan (IRP) that they could agree to jointly and present as a planning tool for the State. The IRP focuses on resource procurement. [DEEP is now mandated to create an Integrated Resource Plan]. Its most important features, to be discussed below in more detail, are its coordinated approach to procurement and its emphasis on energy reliability and efficiency. In the end, all of Connecticut's and New England's plans for the future of the electric system are designed to make changes in the system happen more smoothly, so electric service will not be disrupted, and more efficiently, so electric service will be worth its price.

ELECTRIC DEMAND

Load and Load Forecasting

The principal term for describing electric load is "demand," which can be thought of as the rate at which electric energy is consumed. (This is not to be confused with "energy", which is the total work done over a given period of time by the electricity and will be discussed later.) The most familiar unit of load or demand is a "Watt"; however, since utility companies serve loads on a much larger scale, forecasts typically use the unit of a megawatt (MW), or one million watts[1].

Loads increase with any increase in the number of electrical devices being used at the same time. Demand also depends on the type of electrical loads and how much work is being performed by those devices. Generally, the higher the electrical loads, the more the stress on the electrical infrastructure. Higher loads result in more generators having to run, and run at higher ~~outputs.~~output levels. Transmission lines must carry more current to transformers located at the various substations. The transformers in turn must carry more electrical load, and supply it to the distribution feeders, which must carry more current to supply the end users. In order to maintain reliability and predict when infrastructure must be added, upgraded, and replaced to serve customers adequately, utilities must have a meaningful and reasonably accurate estimate or projection of future loads. The process of calculating future loads is called "load forecasting."

Load forecasting by the three Connecticut utilities is broken down by each company's respective service area. UI serves 17 municipalities in the New Haven area near the coast from Fairfield to North Branford and north to Hamden. The Connecticut Municipal Electric Energy Cooperative (CMEEC) collectively serves all of the municipal utilities in Connecticut, namely the cities of Groton and Norwich; the Borough of Jewett City; the Second (South Norwalk) and Third (East Norwalk) Taxing Districts of the City of Norwalk; the towns of Wallingford and Groton; and the Mohegan Tribal Utility Authority. The largest transmission/distribution company is CL&P. CL&P serves all of the remaining municipalities in Connecticut. Collectively, at a given time, the sum of

CL&P, UI, and CMEEC loads is equal to the Connecticut load. The Council is mandated by statute to review these three forecasts for the Connecticut load.

In addition to producing its regional forecast, ISO-NE prepares individual forecasts for each of the New England states, including Connecticut. The Council acknowledges the importance of this forecast by reviewing it in parallel with the sum of the CL&P, UI, and CMEEC forecasts, even though the statute does not specifically require the Council to do so.

Peak Load Forecasting

Load forecasting focuses primarily on peak load, that is, the highest hourly load experienced during the year. Peak load is more important than typical or average load because the peak represents a clearly-defined worst-case stress on the electric system. Connecticut experiences its peak load during a hot, humid summer day. This is because air conditioning generally creates one of the largest components of demand for power.

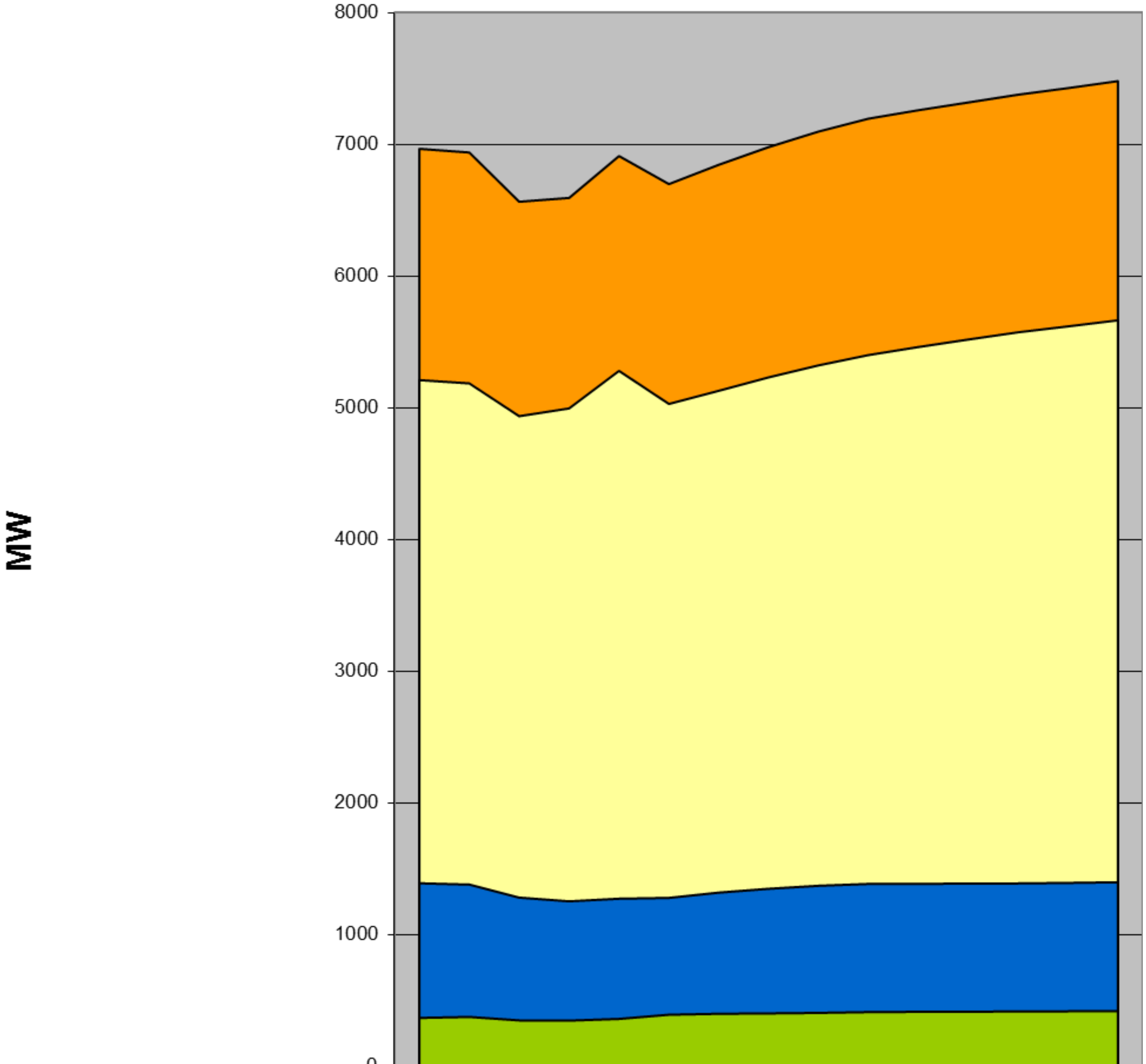
While winter months in Connecticut do have periods of significant loads, winter peaks are generally lower than summer peaks because most of the energy for heating is supplied directly by fossil fuels, not by electricity. While natural gas or oil furnaces do typically require electricity for blowers/fans, pumps, and control systems, this electrical load is small compared with the load from air conditioning, which runs entirely on electricity. (There are some natural gas-fueled air conditioning systems, but they are not common.) Conversely, in areas where electric heat is common and there is less demand for air conditioning, such as the Canadian province of Quebec, a winter peak load can result.

While a detailed discussion of peak loads would have to include additional factors such as customer usage, demographics, conservation efforts, economic conditions, and others, the most important factor is weather—specifically the temperature and humidity. Higher temperatures result in more frequent use of air conditioning, and the units work harder, consuming more electricity. Also, higher humidity can exacerbate the situation, as it can make the temperature feel hotter than it actually is (raising what is sometimes called the "heat index") and further encourage air conditioning use.

In order to account for weather effects as accurately as possible (for financial planning purposes, not infrastructure planning), the Connecticut transmission/distribution companies provide a forecast based on "normal weather", or assumed temperatures consistent with approximately the past 30 years of meteorological data. This is also referred to as the "50/50" forecast, which means that, in a given year, the probability of the projected peak load being exceeded is 50 percent, while the probability that the actual peak load would be less than predicted is also 50 percent. Another way of considering this 50/50 forecast would be to say that it has the probability of being exceeded, on average, once every two years.

In its normal weather (50/50) forecast, CL&P predicted a peak load of 5028 MW for its service area during 2012. This load is expected to grow during the forecast period at an annual compound growth rate (ACGR) of 1.33 percent, reaching 5663 MW in 2021. UI predicted, in its normal weather (50/50) forecast, a peak load of 1278 MW for its service area during 2012. This load is expected to grow during the forecast period at an ACGR of 0.99 percent, reaching 1397 MW in 2021. CMEEC predicted, in its normal weather (50/50) forecast, a peak load of 391 MW for its service area during 2012. This load is expected to grow during the forecast period at an ACGR of 0.77 percent, reaching 419 MW in 2021[2]. All three of the State utilities' 50/50 summer peak loads are depicted in Figure 1a.

Figure 1a: Utility Adjusted Historical & 50/50 Peak Load Forecast in MW



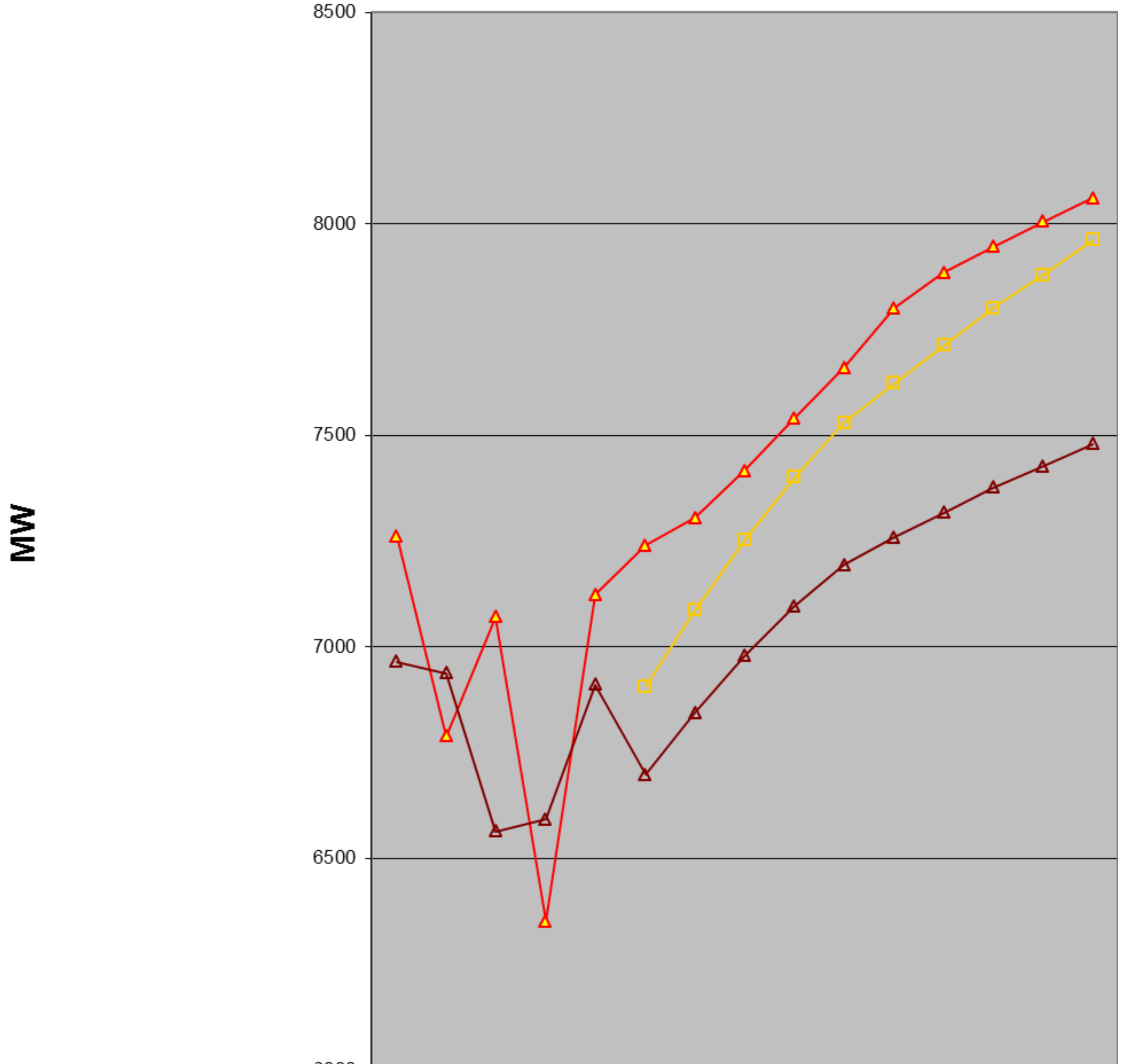
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
CT Utilities Historical & 50/50 Forecast Peak w/C&LM & DG	6965	6937	6563	6592	6910	6697	6844	6978	7096	7194	7258	7317	7376	7426	7479
CL&P Historical & 50/50 Forecast Peak	5209	5184	4935	4994	5279	5028	5128	5230	5321	5399	5460	5517	5572	5617	5663
UI Historical & 50/50 Forecast Peak	1389	1379	1280	1252	1272	1278	1318	1347	1370	1384	1385	1386	1388	1392	1397
CMEEC Historical & 50/50 Forecast Peak	367	374	348	346	359	391	398	401	405	411	413	414	416	417	419

Megawatts

The sum of the three utilities' forecasts resulted in a projected statewide peak load of 6697 MW during 2012. This load is expected to grow at an ACGR of 1.23 percent and reach 7479 MW by year 2021. The statewide ACGR is a weighted average of the three utilities' ACGRs. Since CL&P has the largest service area in Connecticut, and its customers are the dominant source of load in the State, it is not surprising that the statewide ACGR of 1.23 percent is comparable to CL&P's ACGR of 1.33 percent. The statewide ACGR is lower than CL&P's due to the effect of slower projected growth rates in UI and CMEEC territories. (See Figure 1a.) The Council notes that the sum of three utilities' forecasts can only approximate the Connecticut peak load. Because temperatures and customer usage patterns vary across the State, the three utilities do not necessarily experience their peaks on the same hour and/or same day. Indeed, adding the three utilities' forecasts may slightly overstate the peak load in the State, but the error is generally considered quite small.

ISO-NE predicted, in its 50/50 forecast for Connecticut, a peak load of 7240 MW during 2012. This peak load is expected to grow at an ACGR of 1.20 percent and reach 8060 MW by year 2021. Note that the ISO-NE 50/50 forecast exceeds the sum of the utilities' forecasts each year by an average of 568 MW. This is due to a difference in how conservation and load management (C&LM) and distributed generation (DG) are treated, but has no material difference in facility planning. (These topics will be discussed in later sections.) Generally, ISO-NE considers C&LM and DG to be capacity resources (i.e. sources similar to generation) while the Connecticut utilities consider them to be reductions in load. Thus, the forecasts differ by approximately the sum of the C&LM and DG effects. See ISO-NE and the State utilities' forecasts in Figure 1b.

Figure 1b: 50/50 Forecasts in MW



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
CT Utilities Historical & 50/50 Forecast Peak w/o C&LM & DG						6906	7087	7252	7401	7529	7623	7712	7800	7879	7961
ISO-NE 50/50 CT Forecast Peak	7261	6788	7070	6351	7123	7240	7305	7415	7540	7660	7800	7885	7945	8005	8060
CT Utilities Historical & 50/50 Forecast Peak w/C&LM & DG	6965	6937	6563	6592	6910	6697	6844	6978	7096	7194	7258	7317	7376	7426	7479

Megawatts

The ISO-NE 50/50 forecast is depicted in yellow in Figure 1b. The Connecticut utilities peak including the effects of C&LM and DG is depicted in dark red. The Connecticut utilities peak excluding the effects of C&LM and DG are depicted in orange. The orange curve more closely matches the ISO-NE projections and provides an approximately "apples to apples" comparison. This is evident as the curves intersect at approximately year 2016.

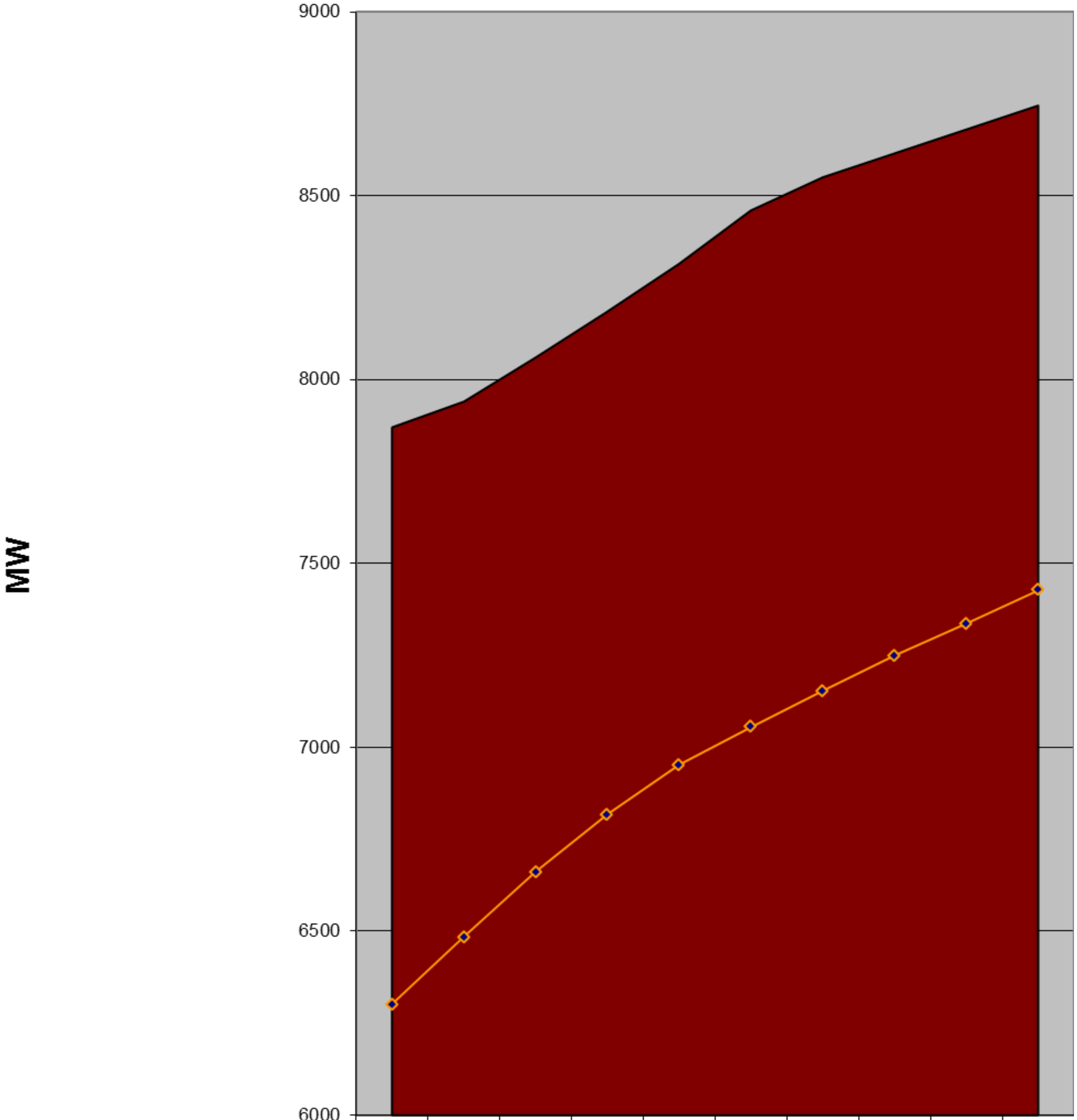
The more significant forecast to be discussed in this review is the one produced by ISO-NE~~. Called~~ called the "90/10" forecast~~, it~~. It is separate from the normal weather (50/50) forecasts offered by the Connecticut utilities. However, it is the one used by both ISO-NE and by the Connecticut utilities for utility infrastructure planning, including both transmission and generation.

A 90/10 forecast is a plausible worst-case hot weather scenario. It means there is only a 10 percent chance that the projected peak load would be exceeded in a given year, while the odds are 90 percent that it would not be exceeded in a given year. Put another way, the forecast would be exceeded, on average, only once every ten years. While this projection is quite conservative, it is reasonable for facility planning because of the potentially severe disruptive consequences of inadequate facilities: brownouts, blackouts, damage to equipment, and other failures.

Utility planners must be conservative in estimating risk because they cannot afford the alternative. Just as bank planners should ensure the health of the financial system by maintaining sufficient collateral to meet worst-case liquidity risks, so load forecasters must ensure the reliability of the electric system by maintaining adequate facilities to meet peak loads in worst-case weather conditions. While over-forecasting can have economic penalties due to excessive and/or unnecessary expenditures on infrastructure, the consequences of under-forecasting can be much more serious. Accordingly, the Council will base its analysis in this review on the ISO-NE 90/10 forecast.

Specifically, ISO-NE's 90/10 forecast has a projected (worst-case) peak load for Connecticut of 7870 MW in 2012. This load is expected to grow at an ACGR of 1.18 percent and reach 8745 MW by 2021. (This is the same as the combined state utility forecast ACGR of 1.23 percent, when rounded to two significant figures.) See Figure 1c.

Figure 1c: Extreme Weather and 90/10 Forecasts in MW



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
ISO-NE 90/10 CT Forecast Peak	7870	7940	8060	8185	8315	8460	8550	8615	8680	8745
CT Utilities Extreme w/o C&LM & DG	6302	6484	6661	6818	6953	7056	7154	7249	7337	7428

Megawatts

[Please confirm the load data in "CT Utilities Extreme w/o C&LM & DG". The load data in Figure 1c is less than that in Figure 1b. For example, the year 2021 value shown here is 7428MW which is lower than the 50/50 forecast of 7961 shown on Figure 1b. 90/10 forecasts with comparable assumptions must be higher than 50/50 forecasts.

Past Accuracy of Peak Load Forecasts

Ten years ago, the Council received the 2002 ten-year forecast reports from the utilities. These reports projected annual peak loads from 2002 through 2011. The Council has compared the 2002 forecasts from CL&P, UI, and CMEEC to the weather-normalized historical peak loads provided by the utilities for 2002 through 2011 in order to determine the percent errors for each utility service area and the State for each of those years.

Since there is ten years' worth of data with a different percent error per year, the percent errors were averaged over ten years to determine the average accuracy of these forecasts. The average percent error was based on the magnitudes or absolute values of the errors. Otherwise, when a sum is taken to compute the average, a positive error one year (or forecast that was too high) would cancel out a negative error another year (or forecast that was too low) and distort the results by making the average error much lower (i.e. closer to zero). For example, if a ten-year forecast is 5 percent too high for five of the years and 5 percent too low for five of the years, the average error over ten years would be zero, taking into account the positive and negative errors. However, when the magnitudes of the errors are used, as the Council has done in this report, this would correctly result in an average error (magnitude) of 5 percent in this hypothetical example.

Also, to prevent distorted results, it is very important to use weather-normalized past (historical) data when making a comparison to forecast projections. (This only works for 50/50 forecasts because the 50/50 forecast is based on "normal" weather.) The reason this is done is to remove the effects of weather. Otherwise, an accurate forecast could appear to be more "wrong" simply because of an unusual (and unforeseen) weather pattern that year. On the other hand, a less accurate forecast could appear to be more "right" by fortunate coincidence that a warmer or cooler than normal weather pattern compensated for a forecast that was too high or low, respectively.

Table 1

Years	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Avg. % Error**
CT Utilities Weather Normalized Historical Loads	6630	6758	6743	7007	6848	6982	6941	6575	6602	6895	
CT Utilities 2002 Forecast Loads	6245	6277	6337	6370	6406	6463	6537	6598	6664	6716	
CL&P Weather Normalized Historical Loads	4988	5093	5056	5277	5084	5209	5184	4935	4994	5279	
CL&P 2002 50/50 Forecast	4757	4780	4826	4856	4887	4938	5004	5063	5123	5169	
UI Weather Normalized Historical Loads	1259	1285	1300	1353	1377	1389	1379	1280	1252	1272	
UI 2002 50/50 Forecast	1195	1198	1204	1204	1207	1210	1216	1216	1220	1223	
CMEEC Weather Normalized Historical Loads	383	380	387	377	387	384	378	360	356	344	
CMEEC 2002 50/50 Forecast	293	299	307	310	312	315	317	319	321	324	
% Error for State 50/50 Forecast	-5.81	-7.12	-6.02	-9.09	-6.45	-7.43	-5.82	0.35	0.94	-2.60	5.16

% Error for CL&P 50/50 Forecast	-4.63	-6.15	-4.55	-7.98	-3.87	-5.20	-3.47	2.59	2.58	-2.08	4.31
% Error for UI 50/50 Forecast	-5.08	-6.77	-7.38	-11.01	-12.35	-12.89	-11.82	-5.00	-2.56	-3.85	7.87
% Error for CMEEC 50/50 Forecast	-23.6	-21.3	-20.7	-17.8	-19.4	-18.0	-16.1	-11.4	-9.8	-5.8	16.39

As noted in Table 1, CL&P's average percent error for the ten-year (2002 through 2011) forecast period is 4.31 percent. UI's average percent error is 7.87 percent. CMEEC's is 16.4 percent. This results in a weighted average state-wide forecast error of 5.16 percent. (As already noted, the state-wide average is weighted more towards CL&P because they serve the largest load.) The Council notes that the accuracy appears to increase later in the forecast period. All three utilities show less error towards the end of the forecast period than the beginning.

Overall, an average Connecticut utilities' forecast accuracy to approximately plus or minus 5.2 percent is very good. In addition, the utilities continue to refine their forecasts, so future forecast accuracy is expected to improve. However, the Council is unable to include the ISO-NE 50/50 forecast in this comparison at this time because ISO-NE does not currently weather-normalize its historical data.

Forecasting Electric Energy Consumption

Energy is the product of the average load and time. As an analogy, load (or rate of energy consumption) can be thought of as the gallons per minute running out of a water faucet to fill a sink. Energy can be thought of as the total number of gallons of water that accumulate in the sink or gallons per minute times the number of minutes.

Accordingly, energy consumption is represented in units of load multiplied by time or Watt-hours. On a household scale and for most electric sales, a unit of kilowatt-hours is used (kWh, or one thousand watt-hours) for energy. On a larger statewide scale, the units used are megawatt-hours (MWh or one million watt-hours), or gigawatt-hours (GWh, or one billion watt-hours).

While load (demand) is measured as an instantaneous snapshot of time (usually recorded hourly by utilities), energy is the total work done by the electricity over time. It can also be thought of as the average load multiplied by the time. Therefore, a smaller load operating for a longer period time could consume as much energy as larger load operating for a smaller amount of time.

For example, a 23-Watt compact fluorescent light bulb consumes electricity at a rate of 23 Watts. If the bulb were on for ten hours, the total energy consumed would be 230 Watt-hours or 0.23 kWh. A much larger load, for example, a 1,500 Watt electric heater, would only have to run for approximately 9.2 minutes (0.153 hours) to consume 0.23 kWh of energy. A household or business electric meter essentially records the sum of the energy in kilowatt-hours of all loads that have operated on the premises during the billing period. For larger accounts, meters also record the instantaneous load (i.e. demand).

The three transmission/distribution utilities maintain records of total energy consumption in their service area. This total is generally the sum of the customers' consumption, the utilities' internal consumption, and losses in the system. The sum of the three utilities' energy consumption, like the sum of their loads, only approximates the electric energy consumption in Connecticut, because some suppliers serve their own needs independently, but this marginal supply is tiny.

CL&P predicted that the total electric energy consumption[3] in its service area would be 23434 GWh during 2012. The calculated ACGR is 0.41 percent. This means the energy consumption is forecast to increase over time. Thus, energy consumption is expected to increase to 24304 GWh by 2021.

UI predicted that the total electric energy consumption in its service area would be 5498 GWh during 2012. UI's projections also result in an ACGR of 0.70 percent. That is, UI's electric energy consumption is expected to slowly increase over the forecast period to reach 5854 GWh by 2021.

CMEEC predicted that the total electric energy consumption in its service area would be 1830 GWh during 2012. This number is expected to grow slowly at an ACGR of 0.64 percent, reaching 1939 GWh by 2021.

Taken together, these data result in a projected statewide electric energy consumption of approximately 30762 GWh for 2012. This number is expected to increase at a (weighted) ACGR of 0.47 percent and reach 32097 GWh by 2021.

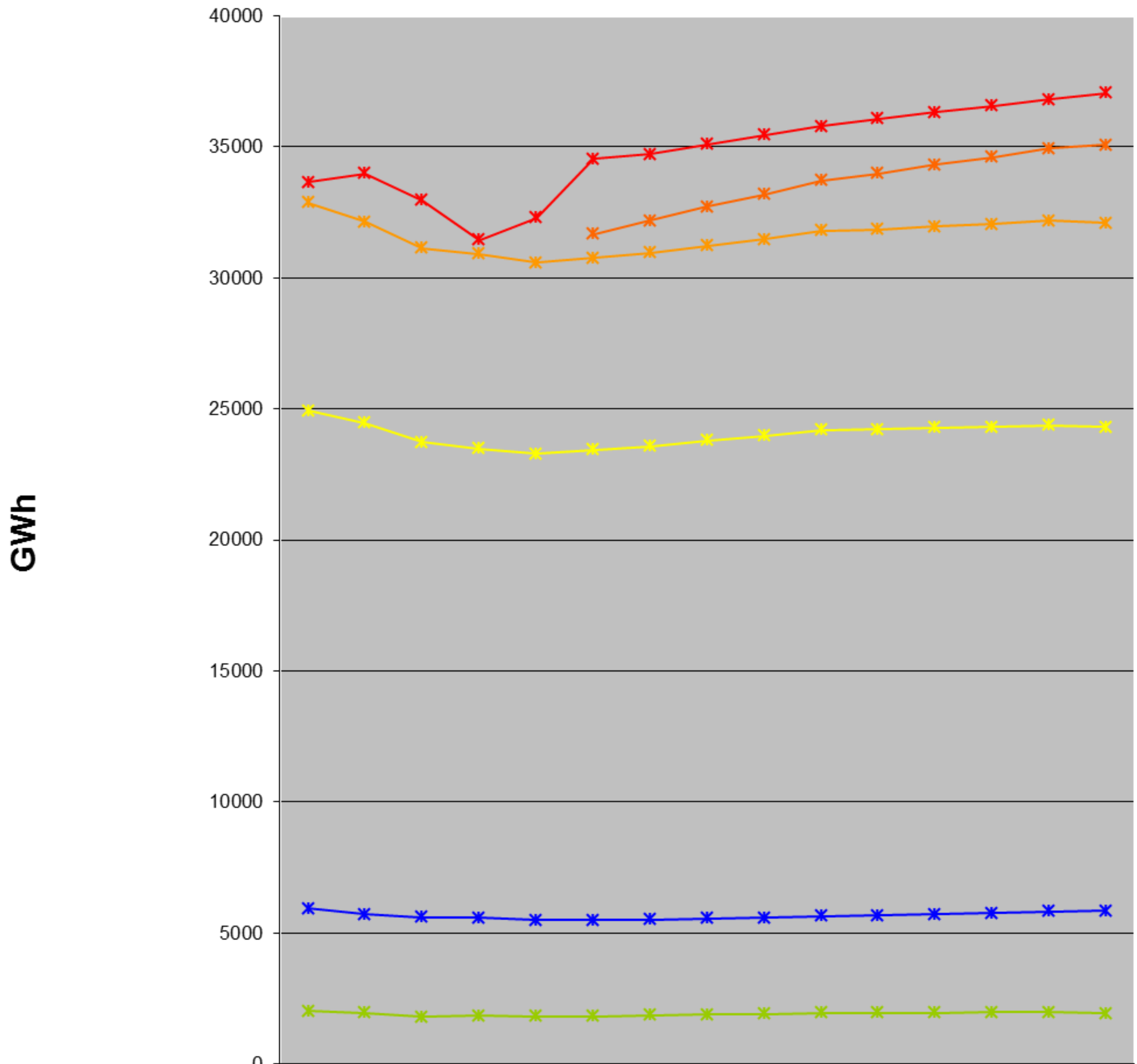
On the surface, the energy consumption ACGR of 0.47 may seem inconsistent with the more than double 1.23 percent ACGR of peak electric load in the State. Actually, it is not. The discrepancy can be explained in terms of changing customer behavior in response to higher electric rates, to technological change, and to various efficiency efforts encouraged by the utilities and the State.

It appears that customers are conserving electricity wherever possible to reduce their electric bills, thus mitigating the average increases in electric energy consumption. On the other hand, demand for air conditioning during the hottest days (and hours) of the year appears to remain strong, and energy consumption during peak periods continues to grow. Since the short peak periods when people tend not to conserve are offset by the much longer periods when people do conserve, the overall trend for electric energy consumption increases more slowly than the growth in peak load.

As is the case with electric load, ISO-NE also provides electric energy consumption data for Connecticut. Specifically, ISO-NE predicts electric energy consumption in Connecticut to be 34545 GWh in 2012. This number is expected to grow at an ACGR of 0.78 percent and reach 37060 GWh by 2021. Figure 2 depicts the four requirement forecasts.

Figure 2 also includes two curves showing Connecticut both with and without Conservation and Load Management (C&LM) and Distributed Generation (DG) (See next section). The curve for Connecticut without C&LM and DG is closer to the ISO-NE curve because of different approaches to C&LM and DG in the modeling done by ISO-NE and the Connecticut utilities, as explained in the next section.

Figure 2: State and Utility Energy Requirements in GWh



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
ISO-NE	33655	33981	32964	31443	32295	34545	34725	35100	35455	35790	36075	36330	36575	36815	37060
CT no C&LM and DG						31681	32177	32715	33185	33730	33993	34316	34620	34949	35073
CT w/C&LM and DG	32875	32134	31136	30907	30586	30762	30953	31234	31482	31807	31854	31965	32059	32180	32097
CL&P	24936	24467	23735	23484	23281	23434	23583	23802	23982	24203	24219	24278	24321	24371	24304
UI	5929	5709	5593	5587	5485	5498	5505	5547	5590	5650	5678	5722	5765	5826	5854
CMEEC	2010	1958	1808	1836	1820	1830	1865	1885	1910	1954	1957	1965	1973	1983	1939

Gigawatt-Hours (GWh)

CONSERVATION AND LOAD MANAGEMENT AND DISTRIBUTED GENERATION

Conservation and Load Management (C&LM) and Distributed Generation (DG) are all types of energy efficiency: that is, they are all methods of reducing load on the electric system without compromising essential service to the end user. Conservation means reducing wasted energy; Load Management means turning off non-essential loads during peak periods; and DG means generation that is connected to a local distribution system, as opposed to transmission.

Of the C&LM and DG components, conservation has the greatest effect on net energy consumption because it is in effect during more hours of the year. Load management tends to have a minimal effect on energy consumption because the savings come during a very limited number of hours. DG has relatively small power outputs currently, so even with greater run time, the effect on net energy consumption is also quite small.

Collectively, these methods of energy efficiency can be considered a reduction in demand or an increase in supply. As mentioned earlier, the Connecticut utilities consider C&LM, DG a reduction in load, while ISO-NE considers it a supply resource. Either way, the net result is the same: less stress on the electric system, reduced need to construct additional generation and transmission, and greater ability to serve loads while reducing pollution and need for fuels, particularly fossil fuels. C&LM, DG can also have economic benefits, since the marginal cost per kW of energy efficiency can be less than that of new generation, depending on the method employed.

The Connecticut Energy Conservation Management Board (ECMB) was created by the Legislature in 1998 to advise and assist the State's utility companies in developing and implementing cost-effective conservation programs to meet Connecticut's changing and growing energy needs. With the approval of the Public Utility Regulatory Authority (PURA), formerly known as the Department of Public Utility Control (DPUC), the ECMB also guides the distribution of the Connecticut Energy Efficiency Fund (CEEF), which finances energy efficiency programs of various kinds all over the State. CEEF's money comes from a surcharge on customer electric bills. Effective July 1, 2011, the CEEF became part of the newly created Clean Energy Finance and Investment Authority (CEFIA).[4]

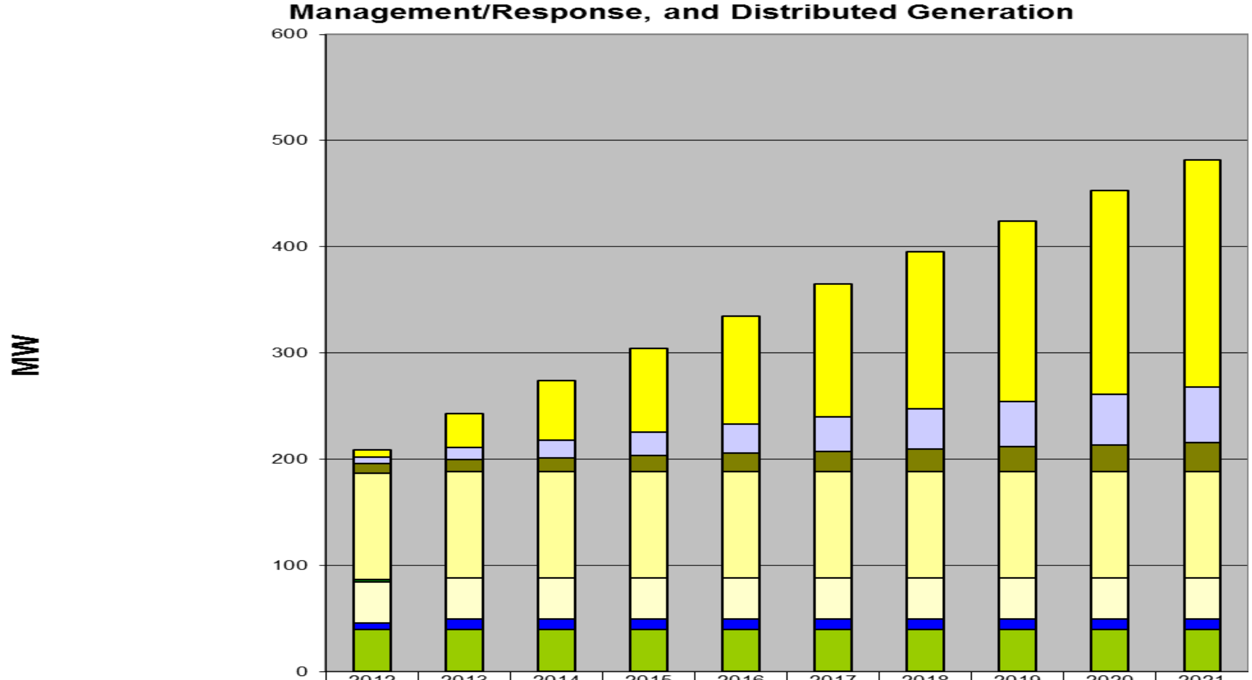
Most of the CEFIA programs are implemented and administered by CL&P and UI, who are also accountable for attaining State-approved performance goals—goals that include reducing both energy consumption and peak load. CMEEC has a separate program for energy efficiency, but with the same goals.

The ECMB submits an annual report to the legislature regarding energy efficiency programs in Connecticut. In the ECMB report dated March 1, 2011, the ECMB notes that the CEFIA programs (for CL&P, UI, and CMEEC) resulted in annual energy savings of 423 GWh or 1.34 percent of the State's 2010 energy consumption, and lifetime savings of 3700 GWh.

UI projected a load reduction[5] (excluding DG) of 5.7 MW in 2012. This number is expected to increase to 52.4 MW by 2021. Load management has been assumed to be zero by UI for the forecast period. This is a conservative assumption given that participation in the load management program is voluntary and difficult to accurately predict. However, CL&P and CMEEC have included their load management projections in their total forecast load reductions. Specifically, CL&P projected a load reduction[6] (excluding DG) of 107 MW in 2012 due to C&LM. This number is expected to grow to 314 MW by 2021. Finally, CMEEC reported a projected load reduction (excluding DG) of 15.4 MW for 2012. This number is expected to grow to 29 MW by 2021.

Collectively, this results in a statewide peak load reduction due to C&LM (and excluding DG) of 128.1 MW in 2012[7]. This cumulative load reduction is projected to increase annually with a substantial ACGR of 13.3 percent and reach 395.4 MW by 2021, the end of the forecast period. By the end of the forecast period, the magnitude of this reduction in load is nearly on the order of the output of the Bridgeport Harbor #3 facility in Bridgeport. Figure 3 depicts the projected annual peak load reduction.

Figure 3: Load Reductions Due to Conservation, Load Management/Response, and Distributed Generation



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
CL&P Conservation	7	32	56	79	102	125	148	170	192	214
UI Conservation	5.7	11.2	16.6	22	27.3	32.5	37.6	42.4	47.4	52.4
CMEEC Conservation	9	11	13	15	17	19	21	23	25	27
CL&P Load Management	100	100	100	100	100	100	100	100	100	100
UI Load Management	0	0	0	0	0	0	0	0	0	0
CMEEC Load Management	2.5	0	0	0	0	0	0	0	0	0
CL&P DG	39	39	39	39	39	39	39	39	39	39
UI DG	5.4	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5
CMEEC DG	40	40	40	40	40	40	40	40	40	40

Megawatts

The Council believes that energy efficiency and programs like CEFIA are an extremely important part of Connecticut's electric energy strategy. Increased efficiency allows the State's electric needs to be met, in part, without incurring the financial costs and the incremental pollution that would be caused by dispatching generation to serve the additional load. Reductions in peak load due to increased efficiency can also impact the schedule of necessary changes to existing utility infrastructure, such as transmission lines and substation equipment (transformers, distribution feeders, etc.) and hence tends to hold down utility costs. Electric energy efficiency also reduces federal congestion costs and the costs of new generation.

In recent forecast years, Connecticut has been among the states leading the country on energy efficiency. It was third in the national rankings put out by the American Council for an Energy-Efficient Economy during 2008, but is now sixth in 2012, due to the impact of the economic conditions on energy efficiency investments. (See annual scorecard at www.aceee.org.) Long-term national projections by the U.S. Department of Energy (DOE) show that employing the most energy-efficient technologies over the next 25 years could decrease energy consumption by 27 percent. Thus, the upside for Connecticut would be considerable if the State were to resume the investment targets in place just three years ago.

ELECTRIC SUPPLY

While peak loads occur during the summer, the electric system is further challenged by the fact that generation output is at its lowest during the summer. This is largely due to lower thermodynamic efficiencies of many plants when the outside temperatures are higher. Accordingly, generators report two different power outputs to ISO-NE. They are referred to as Summer and Winter Seasonal Claimed Capabilities, respectively. (See Appendix A.) Connecticut's August 2011 ISO-NE dispatched generation output is 7965.55 MW in the summer, with a higher total of 8255.70 MW during the winter.

Even taking into account the most conservative forecast (the ISO-NE 90/10 forecast), and the worst-case generating output (the summer output), the Council anticipates that electric generation supply during the forecast period will be adequate to meet demand. Neglecting retirements, going forward, Connecticut has a surplus of generation during the forecast period. Plant retirements would decrease generation; however, the New England East West Solution (NEEWS) transmission projects, to the extent they are approved, would offset generation losses by increasing import capacity. See Table 2, and also the section on Transmission.

New Generation

[Should this section also include a discussion of GenConn Energy's Devon gas turbine plant (187.6 MW) that went into service in June 2010 and GenConn's Middletown gas turbine plant (187.6 MW) that went into service in June 2011?]

The largest addition to Connecticut's generation resources in recent years is the Kleen Energy facility. The 620 MW Kleen Energy facility in Middletown is a natural gas-fired (with oil backup) combined-cycle generating facility. The plant was approved by the Council in Docket No. 225. Kleen was later selected in a request for proposal (RFP) as a project that would significantly reduce federally mandated congestion charges. It went into service in June, 2011. Accordingly, the Kleen Energy plant is reflected in the load/resource balance table (Table 2) based on in-service availability for summer 2011.

The second largest recent addition to Connecticut's electric generation fleet ~~is~~ are three units at New Haven Harbor. These units are ~~oil-fired (jet fuel) combustion~~natural gas turbines. Each unit has a summer rating of 43.2 MW per ISO-NE. This results in a total of nearly 130 MW of available generation for Connecticut.

Public Act 07-242, An Act Concerning Electricity and Energy Efficiency, created an expedited Council review and approval process to facilitate the siting of certain new power plants. The Council is mandated to approve by declaratory ruling:

- the construction of a facility solely for the purpose of generating electricity, other than an electric generating facility that uses nuclear materials or coal as a fuel, at a site where an electric generating facility operated prior to July 1, 2004;
- the construction or location of any fuel cell—unless the Council finds a substantial environmental effect—or of any customer-side distributed resources project or facility or grid-side distributed resources project or facility with a capacity of not more than 65 megawatts, so long as such the project meets the air quality standards of the Department of Environmental Protection;
- the siting of temporary generation solicited by DPUC pursuant to section 16-19ss of this act.

Many projects, instead of being submitted to the Council as applications for Certificates of Environmental Compatibility and Public Need, were submitted as petitions for declaratory ruling under this provision. Several Project 150 proposals (see below) were in this category.

Project 150

Project 150 is a program funded by the CEFIA. The aim of this program is to stimulate Class I renewable energy generation. Applicants that are approved by the Council receive secure funding via long-term power purchase agreements with CL&P and UI. Table 2 reports each applicant's status before the Council, and estimated in-service dates for those already approved. (See also later sections on renewable generation projects.) In the some cases, the actual power to be provided to the utilities under contract for Project 150 could be less than the project's power output. The remaining output may be sold to the grid under other terms/arrangements.

Table 2:	**Renewable**	**Generation**	**Projects**	**Selected in**	**Project 150**
Project	*Location*	*Project MW*	*Contract MW*	*Est. In-service Date*	*Council Review Status*
DFC-ERG Bloomfield	Bloomfield	3.65	3.65	2012*	Approved
DFC-ERG Glastonbury	Glastonbury	3.4	3.4	2012*	Approved
DFC-ERG Milford Project	Milford	9	9	~~2012*~~2012 [Still in the ISO-NE queue. No ISD in 2012 or 2013.]*	Approved
Bridgeport Fuel Cell Park	Bridgeport	14.93	14.93	2012* [should be 2013]	Approved
Plainfield Renewable Energy	Plainfield	37.5	30	2014	Approved
Total Capacity Approved by Council		68.48	60.98		
Project	*Location*	*Project MW*	*Contract MW*	*Est. In-service Date*	*Review Status*
Clearview East Canaan Energy, LLC	North Canaan	3	3	2012*	Not Rec'd
Clearview Renewable Energy, LLC	Bozrah	30	30	2012*	Withdrawn
DFC-ERG Trumbull	Trumbull	3.4	3.4	2013*	Not Rec'd
Stamford Hospital Fuel Cell CHP	Stamford	4.8	4.8	2013*	Not Rec'd
Waterbury Hospital Fuel Cell CHP	Waterbury	2.8	2.8	2012*	Not Rec'd
Cube Fuel Cell	Danbury	3.36	3.36	2013*	Not Rec'd
Other Project Capacity		47.36	47.36		

*Construction has not yet commenced.
Source: CL&P Forecast dated March 1, 2011

Bridgeport Energy II LLC ~~–~~ Bridgeport [Suggest deleting this entire paragraph since Bridgeport Energy II LLC withdrew its ISO-NE generation interconnection request in 2009.]

On June 5, 2008, the Council approved another large fossil-fuel generation project: the Bridgeport Energy II (BEII) facility. This is a 350 MW single cycle natural gas-fired generating plant with ultra low sulfur fuel oil as the backup fuel. It was the subject of Petition No. 841. The plant would be located at the site of the existing 442 MW (summer rating) Bridgeport Energy facility. The BEII project was also selected as an expedited peaking facility. However, the current economic conditions make it unlikely that the project will go forward soon, or at all. Accordingly, at this time, it is not included in the load/resource balance in Table 2 to be conservative.

Montville Power LLC – Montville

On June 22, 2009, Montville Power LLC (MP) submitted a petition (Petition No. 907) for a declaratory ruling that no Certificate is required for the proposed construction, maintenance, and operation of a 40 MW wood biomass-fueled generating facility. Such a facility would replace Montville Unit 5, which is an 81 MW (summer rating) oil and natural gas-fired steam electric generator. The repowered facility could generate up to 40 MW of electricity using wood fuel, and up to 82 MW using natural gas or ultra-low sulfur distillate fuel during high demand periods. The project was approved by the Council on February 25, 2010 and has all its permits. Construction is not complete at this time. Since this is a repowering of nearly equal peak megawatts, the project is not reflected in Table 2.

PSEG Power LLC – New Haven

On November 23, 2009, PSEG Power Connecticut LLC (PSEG) submitted a petition (Petition No. 925) for a declaratory ruling that no Certificate is required for the proposed construction, maintenance, and operation of three ~~48.4~~43.2 MW electric generating peaking units. The units would be dual-fuel (natural gas/oil) and would be able to commence operations within ten minutes of being dispatched by ISO-NE. Black start capability (the ability to start without outside grid power) is also included to improve the reliability of Connecticut's power system.

While the original petition included an overhead electrical connection, PSEG subsequently filed another petition (Petition No. 976) on November 2, 2010 for an underground connection, after that was found to be feasible and of comparable cost to the overhead connection. Petition Nos. 925 and 976 were approved on January 7, 2010 and December 16, 2010, respectively. All three units went into service on June 1, 2012.

Wind Renewable Projects

On November 17, 2010, BNE Energy Inc. (BNE), submitted a petition to the Council for a declaratory ruling that no Certificate is required for the construction, maintenance, and operation of a 3.2 MW Wind Renewable Generating facility at 178 New Haven Road in Prospect, Connecticut. The proposed project is referred to as "Wind Prospect." The Wind Prospect project was denied by the Council on May 12, 2011.

On December 6, 2010, BNE submitted a petition to the Council for a declaratory ruling that no Certificate is required for the construction, maintenance, and operation of a 4.8 MW Wind Renewable Generating facility at Flagg Hill Road in Colebrook, Connecticut. The proposed project is referred to as "Wind Colebrook South." The Wind Colebrook South project was approved by the Council on June 2, 2011.

On December 13, 2010, BNE submitted a petition to the Council for a declaratory ruling that no Certificate is required for the construction, operation, and maintenance of a 4.8

MW Wind Renewable Generating facility located on Winsted-Norfolk Road (Route 44) and Rock Hall Road in Colebrook, Connecticut. The project is referred to as "Wind Colebrook North~~"~~." The Wind Colebrook North project was approved by the Council on June 9, 2011.

While a total of 9.6 MW of new wind generation has been approved by the Council, the precise in-service dates of the projects are not yet known. Accordingly, to be conservative, the wind projects have not yet been included in the current Council forecast.

Demand/Supply Balance

Table 3 contains a tabulation of generation capacity vs. peak loads. The ISO-NE 90/10 forecast is applied in this table. Note that peak load here is combined with a reserve requirement. This is an emergency requirement, basically: in case a large generating unit trips off-line, reserves must be available to compensate rapidly for that loss of capacity. The largest reserve requirement is 1,225 MW, which is approximately the current summer output of the State's largest generating unit, Millstone 3.

Assumed unavailable generation estimates a typical number of power plants off-line for maintenance purposes. Existing generation supply resources are based on the total existing generation in Connecticut listed in Appendix A. Appendix A contains data from ISO-NE's December 2012 Seasonal Claimed Capability report. Approved generation projects (not yet constructed and/or complete) are also included in Table 3. As indicated in Table 3, in-service dates for these facilities are estimates and may be subject to change.

The retirement of older generating units is difficult to predict because it is the result of many factors such as market conditions, environmental regulations and the generating companies' business plans. While NRG Energy Inc. (the owner of several older fossil-fueled steam facilities) testified at the Council's 2012 hearing that it has ~~are~~ no plans at this time to retire facilities during the forecast period, the 2012 IRP has several retirement assumptions in its base case. To maintain consistency, the Council adopts these retirement assumptions, but cautions that they are very tentative and subject to change.

Specifically, the 2012 IRP assumes 938 MW of generating capacity would retire in 2015. This is in addition to the AES Thames Facility (183 MW). (This plant is already out of service.) Thus, Table 3 includes the incremental loss of 938 MW beginning in 2015. (The AES Thames retirement is already taken into account as it shows 0 MW in Appendix A, which provides the Existing Generation data.)

Table 3

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
90/10 Load	7870	7940	8060	8185	8315	8460	8550	8615	8680	8745
Reserve (Equiv. Millstone 3)	1225	1225	1225	1225	1225	1225	1225	1225	1225	1225
Load + Reserve	9095	9165	9285	9410	9540	9685	9775	9840	9905	9970
Existing Generation	8022	8022	8022	8022	8022	8022	8022	8022	8022	8022
Est.Unavail. Generation	576	576	576	576	576	576	576	576	576	576
Available Generation	7446	7446	7446	7446	7446	7446	7446	7446	7446	7446
Normal Import[1]	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Energy Efficiency[2] per Fig. 3	22	54	86	116	146	177	207	235	264	293
Total Avail. Resources	9468	9500	9531	9562	9592	9622	9652	9681	9710	9739
Surplus/Deficiency[3]	**373**	**335**	**246**	**152**	**52**	**-63**	**-123**	**-159**	**-195**	**-231**
Approved Generation Projects										
Ameresco	5	5	5	5	5	5	5	5	5	5
Project 150[4]	16	31	58	96	96	96	96	96	96	96
Ansonia		58	58	58	58	58	58	58	58	58
Surplus/Deficiency	**394**	**429**	**367**	**311**	**211**	**96**	**36**	**0**	**-36**	**-72**
Possible Generation Retirements Per 2010 IRP[5]				-938	-938	-938	-938	-938	-938	-938
Surplus/Deficiency	**394**	**429**	**367**	**-627**	**-727**	**-842**	**-902**	**-938**	**-974**	**-1010**
Future Projects Under Council Review										
NEEWS[6,7,8]	0	0	300	300	700	1100	1100	1100	1100	1100
Future Projects Not Yet Filed[9]										
South Norwalk Renewable Generation (Pro		36	36	36	36	36	36	36	36	36
Stamford Hospital Fuel Cell CHP (Proj. 150		5	5	5	5	5	5	5	5	5
Clearview East Canaan Energy, LLC (Proj.		3	3	3	3	3	3	3	3	3
Waterbury Hospital Fuel Cell CHP (Proj. 15		3	3	3	3	3	3	3	3	3
Cube Fuel Cell (Proj. 150)		3	3	3	3	3	3	3	3	3
DFC-ERG Trumbull (Proj. 150)		3	3	3	3	3	3	3	3	3
CMEEC DG		12	12	12	12	12	12	12	12	12
Total Net Surplus/Deficiency	**394**	**494**	**732**	**-262**	**38**	**323**	**263**	**227**	**191**	**155**

[1]This is an average value. The actual import capacity can range between 1,500 MW to 2,500 MW.

[2]This takes into account only passive (non-dispatched) demand reductions such as energy efficiency, to be conservative.

[3]This is based on a one-in-ten years event and assumes conservative import capacity, no load response, and no newly-approved generation.

[4]Only the Council-approved projects associated with Project 150 are listed in this row.

[5]Such retirements are hypothetical based on certain conditions, and are difficult to predict with certainty at this time, especially since they require ISO-NE approval.

[6]NEEWS is a group of transmission projects, three of which are in Connecticut. The Council has already approved one: the Greater Springfield Reliability Project.

[7]The other NEEWS applications are expected to be received in the future.

[8]The effect of NEEWS on import capacity will ultimately depend on which of the projects are approved and their final configuration(s).

[9]It is not known when these projects will be filed with the Council or whether they would be approved.

Does the existing generation include GenConn Energy's Devon and Middletown projects?

Ansonia Generation has withdrawn its interconnection request with ISO and should not be included as planned generation for the purposes of this table.

Existing Generation

Nuclear Powered Generation

Nuclear plants use nuclear fission (a reaction in which uranium atoms split apart) to produce heat, which in turn generates steam, and the steam pressure operates the turbines that spin the generators. Since no step in the process involves combustion (burning), nuclear plants produce electricity with zero air emissions. Pollutants emitted by fossil-fueled plants are avoided, such as sulfur dioxide (SOx), nitrogen oxides (NOx), mercury, and carbon monoxide. (SOx and NOx contribute to acid rain and smog.) Nuclear plants also do not emit carbon dioxide, which is a significant advantage in the effort to curb greenhouse gas emissions. However, issues remain with regard to security, the short and long-term storage of nuclear waste, and the cost of new plants.

Connecticut currently has two operational nuclear electric generating units (Millstone Unit 2 and Unit 3) contributing a total of 2100 MW of summer capacity, approximately 26.3 percent of the State's generating capacity. The Millstone facility is the largest generating facility in Connecticut by power output.

The former Millstone 1 reactor has been decommissioned in place. Dominion Nuclear Connecticut Inc. (Dominion), owner of the Millstone units, has no plans at this time to construct another nuclear power generating unit at the site.

Dominion submitted license renewal applications to the United States Nuclear Regulatory Commission (NRC) on January 22, 2004. On November 28, 2005, the NRC announced that it had renewed the operating licenses of Unit 2 and Unit 3 for an additional 20 years. With this renewal, the operating license for Unit 2 is extended to July 31, 2035 and the operating license for Unit 3 is extended to November 25, 2045.

On October 29, 2010, the Council received a petition from Dominion for a declaratory ruling that no Certificate is required for the proposed replacement of the Reserve Station Service Transformer and Normal Station Service Transformer for the Millstone Unit 2 facility. On December 2, 2010, the Council approved the petition. This project is expected to maintain reliability at the Millstone facility.

Coal Powered Generation

Connecticut has one active coal-fired electric generating ~~facilities~~facility contributing 383 MW, or approximately 4.8 percent of the State's current capacity. The AES Thames facility, located in Montville, has retired from service. The only active coal-fired generating facility in Connecticut is the Bridgeport Harbor #3 facility located in Bridgeport. This facility burns imported coal and has a summer power output of approximately ~~383.43 MW.~~383 MW.

In general, using coal as fuel has the advantages of an abundant domestic supply (US reserves are projected to last more than 250 years), and an existing rail infrastructure to transport the coal. However, despite the advantages of domestic coal, generators sometimes find imported coal more economical to use. With very low sulfur content, imported coal does not require as much cost for emissions control.

In conventional coal-fired plants, coal is pulverized into a dust and burned to heat steam for operating the turbines. However, burning coal to make electricity causes air pollution. Pollutants emitted include sulfur dioxide, carbon dioxide, and mercury. Coal-fired power plants have high carbon dioxide emissions relative to plants using other fuels; thus, they are considered particularly significant contributors to global warming.

Petroleum Powered Generation

Connecticut currently has 43 oil-fired electric generating facilities contributing 2981 MW, or 37.4 percent of the State's current capacity.

Additional oil-fired generation is not likely in the near future, due to market volatility and mounting oil prices. (However, replacement and/or repowering of existing aging units may occur.) In particular, the price of crude oil currently exceeds $80 per barrel.

Moreover, oil-fired generation presents environmental problems, particularly related to the sulfur content of the oil, and may face tighter air-emissions standards in the near-term, such as regulation of carbon dioxide emissions. Some of the oil-fired generating facilities in Connecticut are dual-fueled, meaning that they can switch to natural gas if necessary. Currently, ~~six~~four generating units in Connecticut (Middletown #2 and #3; Montville #5; New Haven Harbor #1; ~~Pierce; and Waterbury Generation~~), totaling approximately ~~1055~~882 MW, have the ability to change from oil to gas. The Council believes that dual-fuel capability is an important part of diversifying the fuel mix for electric generation, with the benefit of avoiding overdependence on a particular fuel.

[A.L. Pierce and Waterbury Generation currently operate as gas turbines. Recommend removing A.L. Pierce and Waterbury Generation in this statement because it is listing generators that can change from oil to gas; not the other way, from gas to oil.]

Natural Gas Powered Generation

Connecticut currently has 20 natural gas-fired generating units (not including Lake Road[8] which is electrically more a part of Rhode Island than Connecticut) contributing a total of 1,384 MW, or 19.3 percent of the State's generating capacity. This includes additions such as Waterbury Generation, Devon #15-18, Kleen Energy, and Middletown #12-15 with summer ratings of ~~98~~96 MW, 188 MW, 620 MW, and 188 MW, respectively.

Natural gas-fired electric generating facilities are preferred over those burning coal or oil primarily because of higher efficiency, lower initial cost per MW, and lower air pollution. Natural gas generating facilities also have the advantage of being linked directly to their domestic or North American fuel source via a pipeline.

Some natural gas generating plants, such as Bridgeport Energy, Milford Power, Lake Road, and the new Kleen Energy plant are combined-cycle. Added to the primary cycle, in which gas turbines turn the generators to make electricity, is a second cycle, in which waste heat from the first process is used to generate steam: steam pressure then drives another turbine that generates even more electricity. Thus, a combined-cycle plant is highly efficient, with an efficiency on the order of 60 percent. However, the tradeoffs are higher initial costs and increased space requirements for the extra generating unit.

~~Two~~A combined-cycle gas ~~plants —~~plant, the Towantic power plant in Oxford ~~and the NRG facility in Meriden — have~~e has been approved by the Council, but ~~remain~~remains pending due to market conditions. The estimated completion ~~dates are not known at this time.~~date is June 2016. Accordingly, to be conservative, ~~they are~~the Towantic plant is not included in Table 2.

[The NRG generation facility in Meriden has formally submitted their ISO-NE generation withdrawal letter in 2012. NRG has no plans to construct a combined cycle gas plant in Meriden.]

Hydroelectric Power Generation

Connecticut's hydroelectric generation consists of 28 facilities contributing approximately 134 MW, or 1.7 percent of the State's current generating capacity. Hydroelectric generating facilities use a renewable energy source, emit zero air pollutants, and have a long operating life. Also, some hydro units have black start capability. The main obstacle to the development of additional hydroelectric generation in Connecticut is a lack of suitable sites.

FirstLight Power Enterprises, Inc. (FirstLight), Connecticut's largest provider of hydroelectric power, owns the following hydroelectric facilities: Bantam, Bulls Bridge, Falls Village, Robertsville, Scotland, Stevenson, Taftville, Tunnel 1-2, Rocky River, and Tunnel 10. Other hydroelectric facilities (over 5 MW) not owned by FirstLight include Derby Dam and Rainbow Dam located in Shelton and Windsor, respectively.

Solid Waste Power Generation

Connecticut currently has approximately 180 MW of solid waste-fueled generation, or approximately 2.5 percent of the State's generation capacity. The Exeter generating plant in Sterling burns used tires, and has a summer rating of approximately 24 MW. The remaining approximately 156 MW of solid waste-fueled generation includes: Bridgeport ~~(~~Wheelabrator~~);~~; Bristol Resource Recovery Facility (RRF); Lisbon RRF; Preston RRF; Wallingford (Covanta) RRF; and the Connecticut Resource Recovery Agency South Meadows facility. See Table 4.

Table 4

Solid Waste-fueled Generation	**MW**
Bridgeport ~~(~~Wheelabrator~~)~~	58.98
Bristol Resource Recovery Facility	11.98
Lisbon Resource Recovery Facility	13.73
Preston Resource Recovery Facility	16.45
Wallingford Resource Recovery (Covanta) Facility	4.65
Connecticut Resource Recovery Agency - South Meadows Unit #5	25.68
Connecticut Resource Recovery Agency - South Meadows Unit #6	23.74
Exeter Tire-burning Facility	20.06
Total	179.39

Solid waste has the advantage of being a renewable, locally supplied fuel and it contributes to Connecticut's fuel diversity. It is not affected by market price volatility, nor supply disruptions—significant advantages over fossil fuels. In addition, the combustion of solid waste reduces the amount of space needed for landfills.

Recently passed energy legislation encourages the development and expansion of waste-to-energy facilities. Trash-to-energy plants are considered a Class II renewable resource, which could count toward the Renewable Portfolio Standards. (See later section titled "Renewable Portfolio Standards.")

Miscellaneous Distributed Generation

Approximately 134 MW of electricity is generated by 67 independent entities in Connecticut such as schools, businesses, and homes. This portion of generation is not credited to the State's capability to meet demand because ISO-NE does not control its dispatch. However, these privately-owned units do serve to reduce the net load on the grid, particularly during periods of peak demand. They range from 5 kW to 32.5 MW in size and are fueled primarily by natural gas, with several others using oil, solid waste, hydro, landfill gas (essentially methane), and propane. The newest significant addition to this category is the 24.9 MW cogeneration facility at the University of Connecticut. This unit was put into service in August 2005.

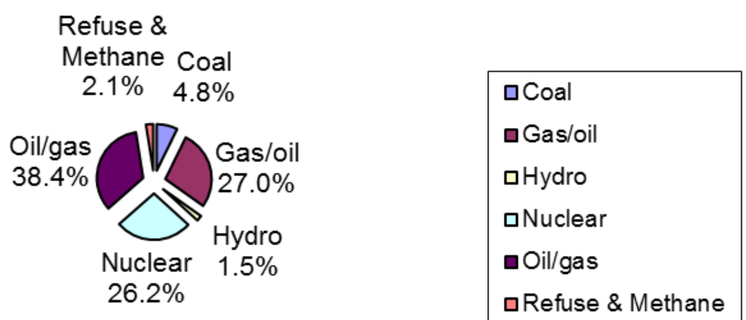
The applications for distributed-connected fuel ~~cell~~cells have been quite steady, and thus the Council has approved seven projects totaling 4,100 kW or 4.1 MW in 2011 so far. These have not been included in Table 1 because they are not ISO-NE dispatched.

A significant portion of the small generation category is supported by programs for clean energy, which include small wind and solar photovoltaic (PV~~.~~). Finally, several unreported units may be in service in Connecticut. Therefore, the total amount of miscellaneous small generation is an approximation at best.

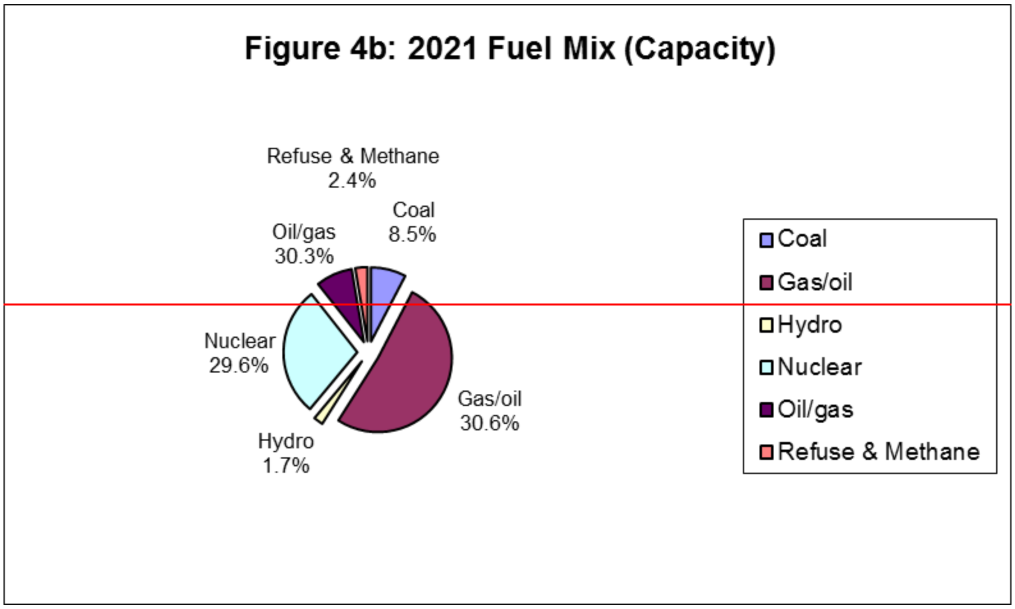
Fuel Mix

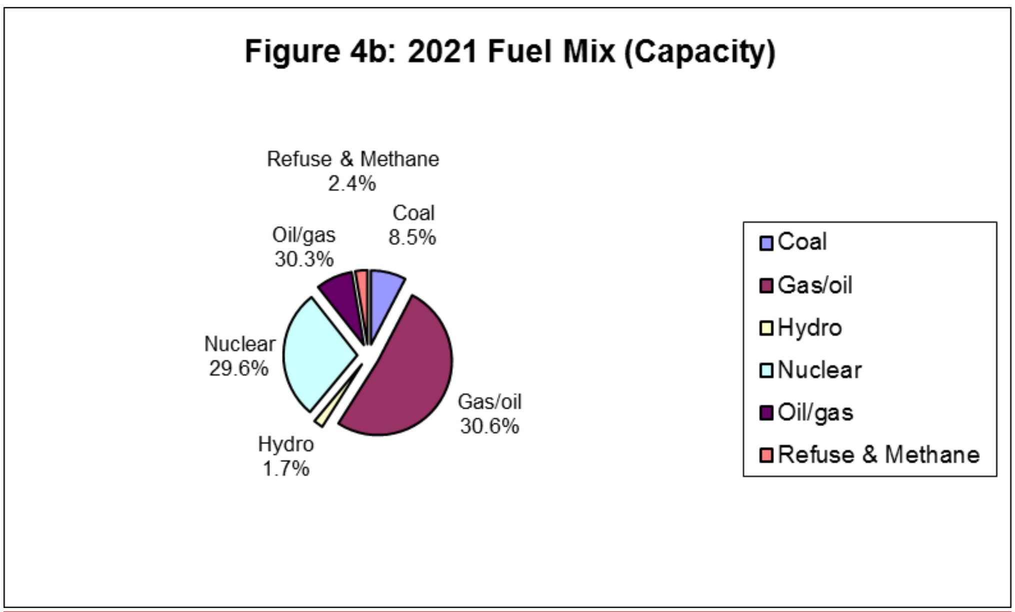
Based on existing generation and future (approved) generation projected in Table 1, the estimated fuel mix (by MW) is provided below for 2012 and also 2021, the end of the forecast period. The retirement assumptions of the 2012 IRP are included in the 2021 Fuel Mix chart. See Figure 4a and 4b below.

Figure 4a: 2012 Fuel Mix (Capacity)



*Lake Road plant (~745 MW) is not included in the fuel mix charts because it is electrically more a part of Rhode Island than Connecticut.





[Given the changes in "Petroleum Powered Generation" above confirm fuel mix data]

Import Capacity

The ability to import electricity plays a significant role in Connecticut's electric supply. It is essential for maximizing reliability and for allowing economic interchange of electric energy. Connecticut can reliably import approximately 1,500 MW to 2,500 MW of power from the neighboring states of New York, Rhode Island, and Massachusetts. 2,500 MW is considered the maximum and best-case scenario at this time. To be conservative, the Council has assumed only 2,000 MW of import capacity.

Connecticut has one 345-kV tie with each bordering state. The 345-kV tie from New York can carry 18 percent of our import capacity. The 345-kV tie from Rhode Island can carry 31 percent. The 345-kV tie from Massachusetts can carry about 32 percent. This results in 81 percent of our imports being carried on high-capacity lines. The remaining power is carried via 115-kV interstate connections.

While the previous imports mentioned have all been on the alternating current (AC) transmission system, there is one direct current (DC) tie between New Haven and Long Island called the Cross Sound Cable. The Cross Sound Cable is 150-kV DC and has a capacity of approximately 330 MW in either direction.

The 2500 MW import capability only represents about 30 percent of the State's peak demand. Looking ahead, CL&P is developing a transmission upgrade plan that would increase the State's import capacity to approximately 45 percent of peak demand. This plan would significantly increase the reliability of Connecticut's supply system and allow for greater import of economical supply. This plan is known as NEEWS. (See Transmission section.)

Market Rules Affecting Supply

Forward Capacity Market (FCM)

Deregulation of the electric system in Connecticut and other New England states was intended to introduce competition into the wholesale market for electric capacity and increase investment in generation while driving prices down. This laudable aim was difficult to achieve, mainly because electricity was and is such a necessity that market rules at the time—as established by FERC and practiced by ISO-NE—imposed penalties suppressing competition on behalf of reliability targets. During a chaotic transition period of about seven years after deregulation, 1998-2005, ISO-NE's authority to enforce reliability brought more control over the increasingly complex and extended electric system into its hands. At the same time, State ratepayers saw prices rise steeply, while diversified generation did not replace traditional resources to the extent expected, and transmission improvements, instead, were proposed and approved by the Council to meet increased load. At length, in 2006 the states reached a settlement with FERC whereby a new electric market in New England was created to satisfy the twin aims of competition and reliability more equally.

This new market, the FCM, starts with ISO-NE's projections of system needs three years in advance, then holds an annual declining auction to purchase generation meeting those needs. The FCM has begun to assure lower pro-rated capacity prices along with reliable supply. It has introduced greater stability to the markets because it: a) assures capacity and price three years ahead; b) establishes rigorous financial tests that generators must pass to qualify for the auction; and c) includes effective rules to enforce auction commitments. Above all, the FCM has succeeded because its rules are more transparent and because it puts traditional generators, renewables, imports and demand response resources more on par. The results of the first five FCM auction results are listed below.

Auction	**Total Qualified**	**Acquired Generation**	**Acquired Demand Resources**	**Acquired Imports**	**Total Capacity Acquired**	**Projected Capacity Need**	**Floor Price**	**Excess Supply**	**Prorated Price**
	MW	MW	MW	MW	MW	MW	$	MW	$
2010/11	39165	30865	2279	933	34077	32305	4.5	1772	4.25
2011/12	42777	32207	2778	2298	37283	32528	3.6	4755	3.12
2012/13	42745	32228	2867	1901	36996	31965	2.95	5031	2.54
2013/14	40412	32247	3261	1993	37501	32127	2.95	5374	2.52
2014/15	40077	31439	3468	2011	36918	33200	3.21	3718	2.86
2015/16	38731	30757	3628	1924	36309	33456	3.43	2583	3.13
Source: ISO-NE Press Release dated April 6, 2012									

<u>Other ISO-NE Markets</u>

ISO-NE runs other wholesale markets, most notably its day-ahead and real-time energy markets, where generators sell actual MW, as opposed to capacity. The smaller markets in which electricity is sold for specialized purposes need not be discussed here: suffice to say that discussion is ongoing within ISO-NE about possible changes to these markets, too, to promote further competition and investment. For a complete overview of New England's wholesale electricity markets, please see the latest Annual Markets Report: http://www.iso-ne.com/markets/mkt_anlys_rpts/annl_mkt_rpts/index.html.

Legislation Affecting Supply

<u>Regional Greenhouse Gas Initiative (RGGI)</u>

RGGI grew out of a compact originally agreed to in 2001 by the governors of the New England states and eastern Canadian provinces to reduce greenhouse gas emissions. The first cap-and-trade program in the U.S., it is modeled after a federal program to curb acid rain started by G.H.W. Bush. A series of steps were taken toward implementation: an inventory of greenhouse gases in the region; a Memo of Understanding signed by member governors (2005); legislative approvals in all member states (2007 in Connecticut). Finally, RGGI began regular quarterly auctions of CO_2 allowances in January 2009. Allowances are essentially emissions permits, with one allowance offered per emission of one ton of CO_2. Power producers pay for the allowances they buy with a surcharge on ratepayers, but RGGI, in turn, pays out the auction proceeds to all ten of its current member states, pro rata, for programs supporting clean energy. In Connecticut, after 12 auctions, $35 million has been repaid into energy-efficiency programs, $12 million to CCEF, and $4 million to other energy programs and administration.

RGGI's first compliance period is up at the end of this year, and the program is being evaluated. It has operated as planned. It has benefited energy efficiency in Connecticut with $51 million. It has demonstrated to the country that cap-and-trade programs can work. What is debatable is its cost-effectiveness in reducing greenhouse gases. Even at the start of RGGI auctions, the "cap", or pool of allowances, was significantly higher than actual emissions. Since then, the steep economic decline, a general electricity sector shift to natural gas, which is lower than other fossil fuels in CO_2 emissions, milder weather (on average), and public acceptance of energy efficiency have mitigated demand for electricity to such an extent that the supply of allowances substantially exceeds demand. In the June 2011 auction about one-third of the allowances went unsold at the floor price. Suggested changes to RGGI include retiring unsold allowances and lowering the cap in 2012, two years earlier than the cap was originally planned to ratchet down.

A continuing uncertainty is how RGGI will relate to new standards for carbon emissions set by the U.S. Environmental Protection Agency (EPA). Although RGGI states have asked EPA to give their power producers flexibility on the basis of RGGI allowances, the EPA has been silent. Also, the lack of a national cap-and-trade bill has isolated RGGI. On account of these and other uncertainties, RGGI's impacts to Connecticut's electric loads and resources cannot be quantified for 2011-2020.

TRANSMISSION SYSTEM

Transmission is often referred to as the "backbone" of the electric system, since it transports large amounts of electricity over long distances efficiently by using high voltage. High voltages are efficient because the laws of physics dictate that the greater the voltage, the greater the amount of electricity the lines can carry, and the smaller the amount of electric energy wasted from the lines as heat.

In Connecticut, electric lines with a line voltage of 69 kilovolts (kV) or more are considered transmission lines. The highest transmission line voltage in Connecticut is 345 kV.

Distribution lines are those below 69-kV. They are the lines that come down our streets to connect (via a transformer) with even lower-voltage lines supplying each residence or business.

The State's electric transmission system contains approximately: 413.1 circuit miles of 345-kV transmission; 1,300 circuit miles of 115-kV transmission; 5.8 circuit miles of 138-kV transmission; and 99.5 circuit miles of 69-kV transmission. (These figures refer to AC transmission. The Cross Sound Cable is not counted because it is DC.) Appendix

B shows planned new transmission, reconductoring, or upgrading of existing lines to meet load growth and/or system operability needs.

Large generating units are typically connected to the 345-kV transmission system because they are higher capacity lines[9]. Older, smaller units are connected to the 115-kV system.

Substations and Switching Stations

A substation is a grouping of electrical equipment including switches, circuit breakers, buses, transformers and controls for switching power circuits and transforming electricity from one voltage to another. One common type of substation connects the transmission system to the distribution system. For example, the input might be 115-kV transmission and the output might be 13.8-kV distribution. Another type of substation connects a generator to the grid. Since a generator's output voltage is much less than the transmission voltage, it has to be raised before the power generated can be fed into the grid. Lastly, some substations, called switching stations, simply interconnect transmission lines to others at the same voltage.

As depicted in Appendix C, as many as four ~~as~~ new substations are planned for the next nine years to address high load areas within the State. Other new substations and/or upgrades to existing substations are also being considered, with the estimated in-service dates to be determined.

Predicting the pace and location of substation development is difficult. Even if predicted load growth overall is low, growth in certain geographical areas can exceed predicted levels due to unplanned population shifts and consequent economic development.

Interstate Connections and Imports

Connections with other systems outside the State are critical to overall reliability and economic efficiency. There are 11 such AC connections or ties: one at 69-kV; one at 138-kV (the underwater set of cables from Norwalk to Long Island); six at 115-kV; and three at 345-kV. In addition, the Cross Sound Cable, a DC tie between New Haven and Long Island, is at 150-kV.

Of these interstate connections, the most prominent are a 345-kV tie with National Grid in Rhode Island; a 345-kV tie with Central Hudson in New York state; and five ties (one 345-kV and four 115-kV) with the Western Massachusetts Electric Company (WMECO).

New England East – West Solution (NEEWS)

In 2006, National Grid, a utility company that provides service in various parts of New England outside of Connecticut, CL&P, and ISO-NE began planning a major tri-state transmission upgrade to improve electricity transfers between Connecticut, Massachusetts, and Rhode Island. Known as NEEWS, the large-scale upgrade is comprised of four separate projects, described below.

The Interstate Reliability Project is the most comprehensive. It would build a new 345-kV transmission line to tie National Grid's Millbury Substation in central Massachusetts with CL&P's Card Street Substation in Lebanon, thus connecting electric service more efficiently from Massachusetts to eastern Connecticut, at the location of an existing connection point with Rhode Island. When combined with the three other projects within NEEWS, this one would increase the east-west power transfer capability across New England in general.

The Greater Springfield Reliability Project improves connections between Connecticut and Massachusetts to address particular problems in the Springfield, Massachusetts area. New 345-kV facilities would be built to tie the WMECO Ludlow Substation with Agawam Substation and also connect Agawam Substation with CL&P's North Bloomfield Substation in Bloomfield. The 345-kV connections from the north to Manchester Substation would also be improved.

The Central Connecticut Reliability Project is proposed to increase the reliability of power transfers from eastern Connecticut to western and southwest Connecticut. A new 345-kV transmission line would connect the North Bloomfield Substation in Bloomfield and the Frost Bridge Substation in Watertown. Associated upgrades to the 115-kV facilities in the area would also be necessary.

The Rhode Island Reliability Project principally would affect Rhode Island. New 115-kV and 345-kV facilities would be built to improve Rhode Island's access to the regional 345-kV grid and decrease its dependence on local generation. National Grid would construct the facilities. Connecticut would be only minimally involved in this project.

Overall, the aggregate of the southern New England transmission reinforcements provided by NEEWS is expected to increase Connecticut's import capacity significantly. The Council has already reviewed and approved The Greater Springfield Reliability Project (GSRP), which is currently under construction. The other applications are expected to be filed with the Council within the forecast period.

Transmission associated with RPS

As has been mentioned in an earlier sub-section on RPS, Connecticut will have to use imports significantly to meet its targets. Six substantial merchant transmission projects have been proposed in the last several years that would bring electricity into southern New England or New York generated by renewable sources farther north. Most of these are planned to run partly or wholly along waterways: routes through Lake Champlain and the Hudson River, the upper reaches of the Connecticut River, or the Atlantic. None of these transmission projects would come directly to Connecticut. All would have to pass a technical evaluation by ISO-NE and siting processes in multiple states. None are at a stage likely to result in an application to the Council during the forecast period.

Electric Transmission in Southwest Connecticut

Dockets 217 and 272

Lying close to New York and along the coast of Long Island Sound, Southwest Connecticut (SWCT) is the most densely-populated part of the State. Well before the turn of the century, it became evident that the 115-kV lines serving SWCT were reaching the limit of their ability to support the area's current and projected loads reliably and economically. ISO-NE, CL&P, and UI devised a large-scale, long-term plan to supplement the existing 115-kV transmission lines with a new 345-kV "loop" though SWCT that would integrate the area better with the 345-kV system in the rest of the State and New England, and provide electricity more efficiently. Council Docket No. 5 was the first phase of this "macro" upgrade: approved in 1975, it connected New Milford and Danbury.

The second phase of the upgrade plan involved the construction of a 345-kV transmission line from Plumtree Substation in Bethel to the Norwalk Substation in Norwalk. This was the subject of Council Docket No. 217, approved by the Council on July 14, 2003. Construction is complete, and the line was activated in October 2006.

The third phase of the upgrade plan was the subject of Council Docket No. 272. This proposal was to construct a 345-kV transmission line from Middletown to Norwalk Substation. It was approved by the Council on April 7, 2005. Construction began in 2006. The project went into service in late 2008.

Glenbrook-Norwalk Cable Project

Within SWCT, a critical sub-area is called the Norwalk-Stamford Sub-Area. Historically, Norwalk and Stamford have relied on local generation. Since generation has become less economical, given electric restructuring, and given the age of generating plants around Norwalk and Stamford, the Norwalk-Stamford Sub-Area had to look at an additional 115-kV transmission line, rather than generation, to meet its increasing needs.

To address these needs, the Council reviewed and approved the construction of two new 115-kV underground transmission cables between the Norwalk Substation in Norwalk and the Glenbrook Substation in Stamford. This project, proposed by CL&P, will effectively bring the reliability benefits of the new 345-kV transmission loop to the large load center in Stamford. It is currently in service.

While the Bethel-Norwalk, Middletown-Norwalk, and Glenbrook-Norwalk projects relieved transmission congestion in SWCT for the near term, as part of prudent planning, ISO-NE is continually reviewing the New England grid to determine future needs.

SWCT is currently being reviewed again by ISO-NE to determine if any further upgrades would be needed to ensure continued reliability going forward.

New Transmission Technologies

Materials and Construction

Within the electric system overall, transmission has been the component slowest to change. In Connecticut, a few innovations have been made, as reported in earlier forecast reviews. Helicopters have been used to install overhead conductors; transmission towers fabricated with new materials are being installed; conductors designed with special-purpose metals and ceramics—so-called “superconductors”—are being tested elsewhere and could be applied at certain sites in Connecticut; new techniques have been employed for laying cables underground.

Storage

Storage is a hybrid in the electricity sector, which can sometimes act as a type of generation (pumped hydro, for instance). Regardless, storage is an area where basic and engineering research is concentrating. Building-sized battery “farms” have been developed; storage systems have been devised using cheap electricity at night to make ice that supplies cooling during the day; flywheels have been engineered that take excess electricity from the grid and return it super-efficiently to balance load; compressed-air storage is quite common; the list goes on. Particularly of interest to Connecticut is the form of storage that uses off-peak electricity to charge electric vehicles (EVs): the entire collection of EVs, in this concept, can function as a medium of storage. Connecticut is one of the few states to have inaugurated an EV charging station, since CL&P has committed to supporting EVs.

Smart Grid

The technological advances most needed are ones that would improve the working of the grid as a whole. In particular, sweeping improvements are needed in the electronics that control the grid, since, as one expert says “[Today’s] switches…operate at a speed that is the equivalent of being 10 days late, relative to the speed of light.”[10] A major innovation in control electronics is at hand that will likely change the organization of transmission, even its operating characteristics: this innovation is known as the “Smart Grid.”

The Smart Grid is a suite of bundled electronic technologies, some currently available, others only speculative. Many of them apply to electricity distribution, but transmission is importantly involved in the Smart Grid too. Although the Smart Grid can be defined in many different ways, a useful definition here comes from the Energy Security and Independence Act of 2007 (EISA), as reported by ISO-NE: “The goal is to use advanced, information-based technologies to increase power grid efficiency, reliability, and flexibility, and reduce the rate at which electric utility infrastructure needs to be built.”[11]

Having anticipated the evolution of the Smart Grid, ISO-NE has already taken some steps to implement it. For instance, ISO-NE has installed phasor measurement equipment at ~~its~~several locations in New England, contributing to wide-area monitoring and situational awareness improvements across the entire Eastern ~~Interconnect to smooth inter-regional power flows.~~Interconnection. Within the distribution system, Connecticut's utilities have been piloting smart meters. Other steps, however, such as a federal effort to establish standards for interoperability among regional transmission systems, have been aborted. In Connecticut, although an aspect of the Smart Grid called a "microgrid" has expressly been authorized by statute, with microgrids initially encouraged in a handful of municipalities, none have been established.

The driver of the Smart Grid at its inception was reliability; the driver currently is efficiency; the driver going forward will be flexibility—that is, the need to integrate renewable resources, and storage. Given the scale of the Smart Grid effort—thousands of billions of dollars over decades—it is difficult to predict how much of an effect it will have on any Connecticut transmission projects during 2012-2021.

RESOURCE PLANNING

Department of Energy and Environmental Protection (DEEP)

PA 11-80 merged the Departments of Environmental Protection and Public Utility Control. Various other energy planning groups were also drawn under the DEEP's umbrella, principally the CEAB. In addition, the executive-legislative liaison regarding energy planning was re-designed, with new DEEP personnel. Perhaps most importantly, the Governor appointed as Commissioner of DEEP ~~a person~~—Dan Esty— a person with extensive credentials at the intersection of environmental policy and energy resource planning.

Connecticut Advisory Board (CEAB) and the Integrated Resource Plan (IRP)

PA 07-242 restructured the CEAB, and required that it conduct studies on how to integrate and coordinate the State's energy entities to achieve the State's greenhouse gas goals, as well as evaluate the efficacy of the State's efficiency program delivery. Under this broad mandate, one of the CEAB's most important new duties was to review and approve an electric resource assessment and procurement plan—a plan to be submitted for approval by UI and CL&P. While the original statute specified that the plan should be annual, in 2009 the statute was revised to require the plan every even-numbered year.

On June 14, 2012, the Department of Energy and Environmental Protection issued the *2012 Integrated Resource Plan for Connecticut* (2012 IRP). In the "Forecast for Future Electricity Supply and Demand" section, the 2012 IRP found the following:

- Connecticut's electricity consumption declined sharply during the economic recession, and is not expected to exceed 2005 levels until 2022.

- Adequate generating resources will likely be available in Connecticut to serve electricity loads reliably through 2022.
- The deliverability of natural gas fuel to electric generators requires monitoring to assure the reliability of electricity supply.
- Connecticut is beginning to experience lower Generation Service Charges, and can expect the downward trend to continue over the next five years.
- Between 2017 and 2022, Generation Service Charges are projected to rise by more than three cents per kilowatt-hour in real terms.
- Air pollution emissions in Connecticut has decreased, as low-cost natural gas-fired generation is displacing coal and oil-fired generation.
- A gap between projected available renewable generation and demand mandated by the Connecticut's and other New England states' renewable generation targets is expected to emerge in 2018.

CONCLUSION

This Council has considered Connecticut's electric energy future and finds that even taking into account the most conservative forecast, the ISO-NE 90/10 forecast, the electric generation supply during 2011-2020 will be adequate to meet demand. Neglecting retirements, going forward, Connecticut has a surplus of generation during the forecast period. When possible retirements are taken into account, the NEEWS projects, to the extent they are approved, would provide additional import capacity to offset such losses.

Connecticut's most significant recent gain in generating capacity is associated with the new 620 MW Kleen Energy power plant in Middletown.

The Council calls attention to the significant improvements to our transmission system that are complete and/or underway. The transmission projects of SWCT are up and running. One NEEWS project has been reviewed and approved by the Council and is under construction, another NEEWS project is currently under consideration by the Council, and applications for the remaining projects are anticipated in the future.

The Council makes the following further observations based on the information presented in this 2012-2021 review.

- A uniform forecasting methodology would be useful for the transmission/distribution companies to consider, consistent with the ISO-NE 90/10 forecast, which is considered the lead forecast.

- Fuel diversity, which is key to Connecticut's policy of energy independence, has been decreasing at the level of power production within the Council's jurisdiction. At the level of DG, however, largely outside the Council's jurisdiction, fuel diversity is markedly increasing.

- Additional interstate transmission resources would allow greater transfer capability into Connecticut, increasing reliability and, of particular importance, helping meet the State's renewable portfolio requirements.

- Smart Grid improvements offer the potential for significant innovation in transmission, particularly with regard to integrating renewables and storage.

- The deactivation/retirement of older generating facilities is foreseeable during this forecast period, and replacing/repowering these facilities offers opportunities for innovation.

End Notes

1. A one MW load would be the equivalent of simultaneously operating 10,000 light bulbs of 100 Watts each. Put another way, 1 MW could serve between 300 and 1,000 homes, with 500 being a typical number.

2. A very small amount of CMEEC load is the result of providing service to Fisher's Island, New York via a connection to a substation in Groton, Connecticut. The peak load is on the order of 1 MW and thus considered negligible relative to the Connecticut load.

3. Electric energy consumption, as used in this report, includes losses. See "Losses" in Glossary.

4. This year, PA 11-80, the same act that formed DEEP, effectively transformed CCEF into a full-scale energy finance authority. It is empowered to leverage both public and private funds for expanded investment.

5. UI's C&LM projections include PA 10-179 reductions which were supposed to occur beginning in 2012. Accordingly, UI's projections are conservative, i.e. on the lower side.

6. The C&LM forecasts were developed in March of 2011 and reflect reduced energy efficiency funding as a result of PA 10-179.

7. Peak load reduction due to C&LM includes Energy Independence Act initiatives, excluding third party contracts.

8. While the Lake Road power plant does provide electricity to Connecticut under normal operating conditions, it is not considered a Connecticut resource by ISO-NE due to the existing transmission configuration. As such, it is not included in this forecast.

9. Since power is directly proportional to voltage, all else being equal, a 345-kV line can carry three times as much power as a 115-kV line. A typical 345-kV line has

two conductors per phase, whereas a typical 115-kV line has one, thus turning the three times power-carrying advantage of a 345-kV line to six times.

10. David Wagman, Power Engineering (March 2011, p. 4).

11. ISO-NE, "Overview of the Smart Grid—Policies, Initiatives, and Needs" (February 17, 2009), p. 1

Glossary

50/50 forecast: A projection of peak electric load assuming normal weather conditions. The 50/50 projected peak load has a 50 percent chance of being exceeded in a given year.

90/10 forecast: A projection of peak electric load assuming extreme (hot) weather conditions. The 90/10 forecast has a 10 percent chance of being exceeded in a given year. This forecast is used for transmission facility planning.

AC (Alternating Current): An electric current that reverses (alternates) its direction of flow periodically. In the United States, this occurs 60 times per second (60 cycles or 60 Hz).

Annual Compound Growth Rate (ACGR): The percentage by which a quantity (such as load or energy) increases per year over the forecast period, on average, while taking into account compounding effects. It is analogous to a computed compound interest rate on a bank account based on a beginning balance and final balance nine years later (assuming no deposits other than interest and no withdrawals). Since it is nine years from the first year of the forecast period to the last, ACGR = (100%*(((Final Value/Initial Value)^(1/9)) – 1).

Ampere (amp): A unit measure for the flow (current) of electricity. As load increases, so does the amperage at any given voltage.

Baseload generator: A generator that operates nearly 24/7 regardless of the system load: for example, a nuclear unit.

Blackout: A total disruption of the power system, usually involving a substantial or total loss of load and generation over a large geographical area.

Black start capability: The capability of a power plant to start generating electricity by itself without any outside source of power, for instance, during a general blackout.

C&LM (Conservation and load management): Any measures to reduce electric usage and provide savings. See Conservation. See Demand response.

Cable: A fully insulated conductor usually installed underground.

CEAB (Connecticut Energy Advisory Board): The CEAB is a 15-member body responsible for coordinating State energy planning, representing the State in regional energy planning, participating in the Council's annual load forecast proceeding, and reviewing the procurement plans submitted by electric distribution companies.

CELT (Capacity, Energy, Load and Transmission Report): An annual ISO-NE report including data and projections for New England's electric system over the next ten years.

CHP (Combined heat and power): Term used interchangeably with cogeneration. See Cogen.

Circuit: A system of conductors (three conductors or three bundles of conductors) through which electrical energy flows between substations. Circuits can be supported above ground by transmission structures or placed underground.

Circuit breaker: A device designed to open and close a circuit manually and also to open the circuit automatically on a predetermined overload of current.

Class I renewable energy source: "(A) energy derived from solar power, wind power, a fuel cell, methane gas from landfills, ocean thermal power, wave or tidal power, low emission advanced renewable energy conversion technologies, a run-of-the-river hydropower facility provided such facility has a generating capacity of not more than five megawatts, does not cause an appreciable change in the river flow, and began operation after the effective date of this section, or a biomass facility, including, but not limited to, a biomass gasification plant that utilizes land clearing debris, tree stumps or other biomass that regenerates or the use of which will not result in a depletion of resources, provided such biomass is cultivated and harvested in a sustainable manner and the average emission rate for such facility is equal to or less than .075 pounds of nitrogen oxides per million BTU of heat input for the previous calendar quarter except that energy derived from a biomass facility with a capacity of less than five hundred kilowatts that began construction before July 1, 2003, may be considered a Class I renewable energy source, provided such biomass is cultivated and harvested in a sustainable manner, or (B) any electrical generation, including distributed generation, generated from a Class I renewable energy source." (Conn. Gen. Stat. § 16-1(a)(26))

Class II renewable energy source: "Energy derived from a trash-to-energy facility, a biomass facility that began operation before July 1, 1998, provided the average emission rate for such facility is equal to or less than 0.2 pounds of nitrogen oxides per million BTU of heat input for the previous calendar quarter, or a run-of-the-river hydropower facility provided such facility has a generating capacity of not more than five megawatts, does not cause an appreciable change in the riverflow, and began operation prior to the effective date of this section." (Conn. Gen. Stat. § 16-1(a)(27))

Class III renewable energy source: "The electricity output from combined heat and power systems with an operating efficiency level of no less than fifty percent that are part of customer-side distributed resources developed at commercial and industrial facilities in this state on or after January 1, 2006, a waste heat recovery system installed on or after April 1, 2007, that produces electrical or thermal energy by capturing preexisting waste heat or pressure from industrial or commercial processes, or the electricity savings created in this state from conservation and load management programs begun on or after January 1, 2006." (Conn. Gen. Stat. § 16-1(a)(44))

CL&P (The Connecticut Light and Power Company): CL&P is the largest transmission/distribution company in Connecticut.

CMEEC (The Connecticut Municipal Electric Energy Cooperative): An "umbrella" group comprised of all of the municipal electric utilities in Connecticut. It manages coordinated generation and transmission/distribution services on their behalf.

Combined-cycle: A power plant that uses its waste heat from a gas turbine to generate even more electricity for a higher overall efficiency (on the order of 60 percent).

Conductor: A metallic wire, ~~busbar~~bus bar, rod, tube or cable, usually made of copper or aluminum~~,~~ that serves as a path for electric flow.

Cogen (Cogeneration plant): A power plant that produces electricity and uses its waste heat for a useful purpose. For example, cogeneration plants heat buildings, provide domestic hot water, or provide heat or steam for industrial processes.

Conservation: The act of using less electricity. Conservation can be achieved by cutting out certain activities that use electricity, or by adopting energy efficiencies.

Customer-side distributed resource: "The generation of electricity from a unit with a rating of not more than sixty-five megawatts on the premises of a retail end user within the transmission and distribution system including, but not limited to, fuel cells, photovoltaic systems or small wind turbines, or a reduction in demand for electricity on the premises of a retail end user in the distribution system through methods of conservation and load management, including, but not limited to, peak reduction systems and demand response systems." (Conn. Gen. Stat. § 16-1(a)(40))

DC (Direct Current): An electric current that flows continuously in one direction as contrasted to an alternating current (AC).

Dual-fuel: The ability of a generator to operate on two different fuels, typically oil and natural gas. Economics, the availability of fuels and environmental (e.g. air emission) restrictions are factors that generating companies consider when deciding which fuel to burn.

Demand: The total amount of electricity required at any given instant by an electric customers. "Demand" can be used interchangeably with the term "load". See Load.

Demand response: The ability to reduce load during peak hours, by turning down/off air conditioning units, industrial equipment, etc. Demand response resources on a scale large enough to affect transmission are typically aggregated through a third party, using automated controls.

Distribution: The part of the electric delivery system that operates at less than 69,000 volts. Generally, the distribution system connects a substation to an end user.

Distributed generation: Generating units (usually on the customer's premises) that connect to the electric distribution system, not to the transmission system. These units are generally smaller than their counterparts.

Energy (electric): The total work done by electricity. Energy is the product of the average load and time. The unit is kilowatt hours (kWh).

Energy efficiency (in the case of an electric generator or of any dynamic process): The actual amount of energy required to accomplish a task as contrasted to a theoretical 100 percent efficiency.

Feeder: Conductors forming a circuit that are part of the distribution system. See Distribution. See Circuit.

Fuel cell: Fuel cells are devices that produce electricity and heat by combining fuel and oxygen in an electrochemical reaction. A battery is a form of fuel cell. Fuel cells can operate on a variety of fuels, including natural gas, propane, landfill gas, and hydrogen. Unlike traditional generating technologies, fuel cells do not use a combustion process that converts fuel into heat and mechanical energy. Rather, a fuel cell converts chemical energy into heat and electrical energy. This process results in quiet operation, low emissions, and high efficiencies. Nearly all commercially-installed fuel cells operate in a cogeneration mode. See Cogen. In addition, fuel cells provide very reliable electricity and are therefore potentially attractive to customers operating sensitive electronic equipment.

Generator: A device that produces electricity. See Baseload generator, Intermediate generator, and Peaking generator.

Grid: A system of interconnected power lines and generators that is managed so that the generators are dispatched as needed to meet the overall requirements of the customers connected to the grid at various points. "Grid" has the same meaning as "bulk power system."

Grid-side distributed resource: "The generation of electricity from a unit with a rating of not more than sixty-five megawatts that is connected to the transmission or distribution system, which units may include, but are not limited to, units used primarily to generate electricity to meet peak demand." (Conn. Gen. Stat. § 16-1(a)(43))

ISO-NE: (ISO New England): An entity charged by the federal government to oversee the bulk power system and the electric energy market in the New England region.

Intermediate generator: A generator that operates approximately 50 to 60 percent of the time, depending on the system load.

kV (kilovolt): One thousand volts (i.e. 345 kV = 345,000 volts). See Volt.

Line: A series of overhead transmission structures that support one or more circuits; or, in the case of underground construction, a single electric circuit.

Load: Amount of power delivered, as required, at any point or points in the system. Load is created by the aggregate load (demand) of customers' equipment (residential, commercial, and industrial).

Load management: Steps taken to reduce demand for electricity at peak load times or to shift some of the demand to off-peak times. The reduction may be made with reference to peak hours, peak days or peak seasons. Electric peaks are mainly caused by high air-conditioning use, so air-conditioners are the prime targets for load management efforts. Utilities or businesses that provide load management services pay customers to reduce load through a variety of manual or remotely-controlled methods.

Loss or losses: Electric energy that is lost as heat and cannot be used to serve end users. There are losses in both the transmission and the distribution system. Higher voltages help reduce losses.

Megawatt (MW): One million Watts. A measure of the rate at which useful work is done by electricity.

Normal weather: Temperatures and humidity consistent with past meteorological data.

Peak load: The highest electric load experienced during a given time period. See Load.

Peaking unit: A generator that can start under short notice (e.g. 10 to 30 minutes). Peaking units typically operate less than 10 percent of the hours in a year.

Substation: Electric facilities that use equipment to switch, control and change voltages for the transmission and distribution of electrical energy.

Switching station: A type of substation where no change in voltage occurs.

Terminal structure: A structure typically within a substation that physically ends a section of transmission line.

Transformer: A device used to change voltage levels to facilitate the efficient transfer of electrical energy from the generating plant to the ultimate customer.

Transmission line: Any electric line operating at 69,000 or more volts.

Transmission tie-line or tie: A transmission line that connects two separate transmission systems. In the context of this report, a tie is a transmission line that crosses state boundaries and connects the transmission systems of two states.

UI (The United Illuminating Company): A transmission/distribution company that serves customers in the New Haven – Bridgeport area and its vicinity.

Voltage or volts: A measure of electric force.

Wire: See Conductor.