STATE OF CONNECTICUT
PUBLIC UTILITIES REGULATORY AUTHORITY

Docket No. 26-05-10
APPLICATION OF THE CONNECTICUT LIGHT AND POWER COMPANY
D/B/A EVERSOURCE ENERGY
TO AMEND ITS RATE SCHEDULES

DIRECT TESTIMONY OF

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Summary- Don't promote heat pumps with promotional heat pumps distribution rates due to the high marginal generation cost for heat pump load….or at lest wait until the Comprehensive IRP is completed.

Q. Please Identify yourself

A. I am Robert Keen, a retired power engineer, residing in Simsbury, Connecticut. I sometimes call myself a "self-appointed consumer advocate" as too little is being done to keep energy affordable for consumers. In particular many of the net zero programs such as residential solar and heat pumps are very expensive and rely on cost shifting to others to subsidize them.

My experience includes regulatory economics, nuclear project management and business development, cogen project development, wholesale and retail marketing, customer cost assessment, development of products for the ISO market and participation in the ISO Planning Advisory Committee.

I worked for Philadelphia Electric, Institute for Environmental Studies- Energy Systems and Policy Research Group, Combustion Engineering/ ABB, and Northeast Utilities,

My formal education includes Cornell University- BS With Distinction in Electrical Engineering (Power Emphasis) where I studied Regulatory Economics from Fred Kahn, MS in Nuclear Engineering at the University of Wisconsin where my master's thesis was a simulation model for the state's electric distribution systems, and an MBA from the University of Connecticut. Charlie Cicchetti was a faculty member of the Wisconsin research group and drove the marginal cost pricing foundation of Fred Kahn when he became Chairman of the Wisconsin PSC and issued the Madison Gas and Electric decision. It resulted in the massive NARUC/EEI/EPRI Electric Utility Rate Design Study (EURDS) to address marginal costs and rate design.

As a result of this regulatory economics experience I am very sensitive to the marginal cost issues.

Q. What are your concerns?

A. I am concerned we are making the same mistakes of the 1960s in which electric heating was promoted with 1 c/kWh power. Customers were upset in the 1970s when prices increased. Customers felt we lied to them.

Like wise today we are not being honest about the cost of serving heating load, both the cost per unit and the huge increase in load (57GW total) and capacity needed to meet policy goals.

Customers are upset with the recent and proposed rate increases which are basically for commodities and "keep the wheels on" maintenance. The increases don't begin to address the large cost of building the NetZero policy system and electrifying heating whose load is will double the winter peak.

It gets worse. Many costs used in generation studies underestimate the costs:

A. They ignore general inflation and specific power industry supply issues that this docket notes have increased costs 400% over the past 6 years.
B. They start with capital costs that are too low and use national lab data that forecasts large learning curve declines in costs that may not be realistic.
C. They generally do not address the T&D delivery costs.

Q. Have you provided input to state agencies on heating costs before?

A. Yes. The ISO EPCET presentation of Oct 23, 2023 analyzed the system with and without HP and EV loads and noted the "not proportionate" costs of the electrification loads. A simple calculation revealed the marginal cost of HP loads to be **4+ times the base load** and without HP/EV 90% of the expensive controversial offshore wind and 50% of the storage would not be needed. I've tried to convey this alarm at every chance I get:

A. In May 2024 I presented a summary of the EPCET findings along with the enclosed graph (figure 2) of heating costs as a function of fuel type and efficiency to a DEEP technical meeting. I recommended that HP conversions be targeted for electric resistance heating and hot water heating because it would reduce the expensive demand on the grid while the other conversions (e.g. oil to HP) would increase the expensive grid demand and also would not have as large a payback.
B. In November 2025 I submitted comments to the Standard Service docket recommending Winter pricing for generation service to avoid the $1.4B subsidy (NE wide) of heat pumps by the present base load. I provided the ISO wholesale load monthly cost curve below (figure 1) and the key slides from the ISO EPCET. Note also the marginal CO2 emissions due to HP in 2032 are twice the emissions rate today.
C. On November 18, 2025 I presented "Heat Pumps to Escalate Procurement Costs and Volatility" to a technical session on the procurement Docket 12-06-02RE04. I recommended the best solution is to not create the problem by promoting heat pumps. We should educate customers (and the other states who are increasing our costs by promoting HP as there is one market) on the high cost of serving heat pump load. We should not subsidize HP conversions nor HP electricity. Winter generation costs 20 c/kWh and should priced at 20 c/kWh (with marginal peaks over 40 c/kwh).
D. In September 2025 I provided extensive input to the CT 2025 IRP noting in response to their #1 question on improving affordability "*The answer is simple- don't electrify especially heating*". I specifically recommended that the IRP model be run with and without heat pumps to determine the true marginal cost of heat pumps. I haven't seen any IRP results.
E. I've made numerous comments on legislative bills primarily on the high cost of heat pump electricity and recommending grid scale solar/storage costing ¼ of residential net metering solar/storage.
F. I've submitted comments on the Solar Successor program four times.

G. I've commented on extremely high cost of the Framingham heat pump thermal loop. My share of the $24M project for a 2500 sq. ft. home would be $400,000, and it would increase my annual operating costs. While the grid impact of geothermal HP is less, the high capital costs eliminate thermal loops as a wide spread solution. (The Eversource Framingham project team was very responsive and provided cost filings 1 hour after my request.)

Q. How much of this $700+M rate case does the net metered solar customer pay?

A. The residential solar customers won't pay for any of this $700+M rate increase. Not now nor for any rate increases in the future for the next 20 years of the solar contract.

In California the cost shift from netting solar contracted is causing the pain for non-solar customers.

Although net metering ended several years ago, the cost shift continues to grow for the legacy contracts. 25% of the present non-solar customer's costs is payment for the solar cost shift according to an LATimes article.

It is the inequity that has the LATimes and the NRDC opposed to net metering in California. Legislators are trying to modify the existing contracts to reduce solar customer benefits.

In Connecticut about 5?% of load is net metered solar that will not contribute to the cost of running the grid. Hopefully the Solar Successor program will control these costs. But there appear to be no limits on solar capacity if the solar system includes storage.

Q. What actions would you like taken?

A. We should not implement the heat pump promotional distribution rates proposed in this docket or at least have the decision deferred until after the Comprehensive Integrated Resource Plan (CIRP) that Eversource proposes is completed and a plan is developed and <u>implemented</u> (such as more gas pipeline capacity that is only charged to the heat pump customers) such that the heat pumps do not cause an increase in the total cost **including generation** of non- heat pump users.

With promotional rates we are sending the wrong message. Heat pumps will be very costly to supply the generation. We should be educating customers on the high cost of heating load.

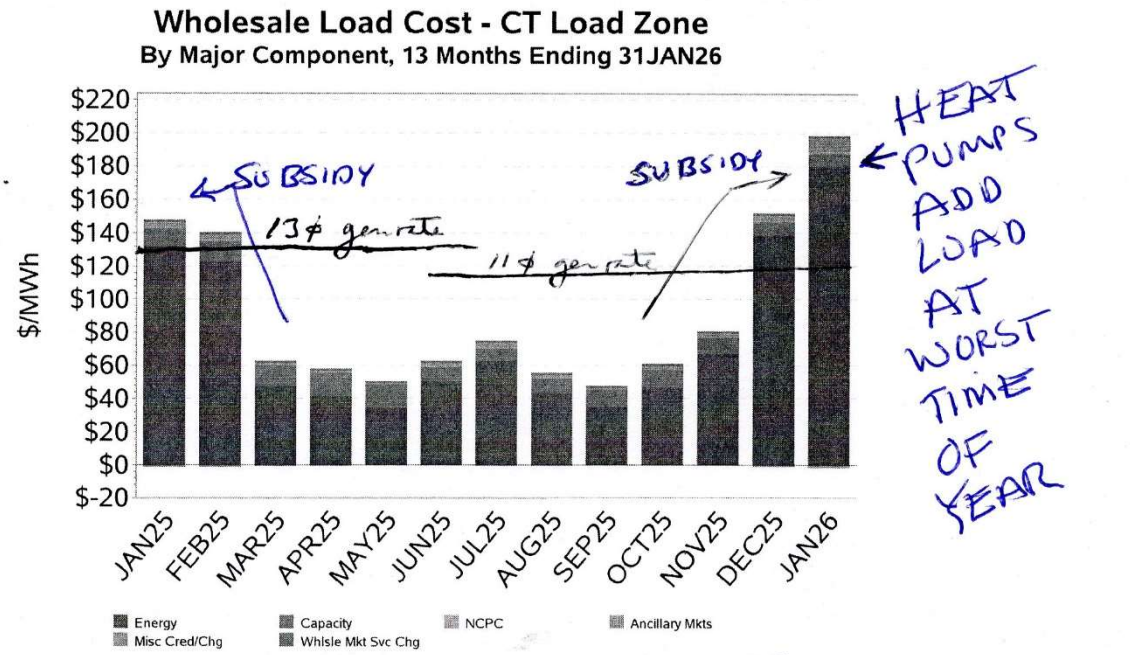
The docket needs to also **consider heat pump generation costs** in addition to distribution costs. Figure 1 below illustrates the large cost differential between heating and non-heating months and the large subsidy of heating by the non-heating months that occurs with 6 month average pricing.

Q. Should we encourage heating load that will soon be the system peak?

A. No. Common sense says we should not offer promotional marginal cost rates for load that will soon be on the system peak……And especially if that load causes the new system peak….

And even more so if that new system peak is a volatile, weather driven, low load factor peak that is extremely expensive to serve.

Figure 1 Actual Wholesale Monthly Cost of Serving Load that shows subsidy of winter load by non-winter load due to 6 month average generation pricing.



The same marginal pricing principles that were applied to the distribution rates should be applied to the generation service rate.

Q. What input would you like to provide on the Comprehensive IRP?

A. First I would like to say the CIRP is of the utmost importance. We are making large investments without updated costs, without considering all the alternatives, and without examining all the marginal costs.

A. The solar costs should include the excellent work to define solar integration costs (SAVE) summarized in this docket.
B. The cost of adding capacity for electrified homes shown on the SAVE slides should be included in the heat pump rates.
C. The cost and allocation of transmission to bring remote renewables should be included such as the new transmission line from Maine to Boston at $2000/kW which is being socialized.
D. All scenarios should be run with and without heating load to determine its marginal cost.
E. All parties(the public, legislature, government agencies, etc) should be involved as it is the common understanding that evolves from the planning process that is more important than the actual plan. President Eisenhower described his D-Day planning process: "*Plans are worthless, but planning is everything*"

Q. What does the above cost curve (Figure 1) suggest about pricing for heating loads?

A. We should **implement monthly or winter seasonal generation prices for heat pumps**. My CNG gas bill has prices for the actual cost of the commodity that varies up to 2 times from warm to cold months. My heat pump electric bill should also have monthly generation prices otherwise non-heat pump customers will be paying a large subsidy to heat pump customers.....and the generation cost for all customers will increase as more and more heat pumps are installed.

We should also consider real time pricing if we want a heat pump load to return to the legacy system during cold spells to control generation costs.

My comments on the Standard Service docket suggesting a 3 month winter seasonal generation offer are attached. It also includes slides from the ISO EPCET October 2023 presentation showing he high cost of heating load.

Q. Why is heating load expensive to serve?

Heating an expensive lood to serve no matter which generation type is chosen (wind, solar, gas, nuclear, etc) because:

A. It's a low 13.7% load factor spike load which means the it requires 4 times the capacity (capital investment) to supply per MWH as the 55% base load and 6 times the capacity as a 90% load factor data center load.
B. It varies 2 times from warm to cold year. You still must build the capacity to serve the cold year , but it may only run for several weeks every 2-3 years.
C. It occurs when gas is not available so expensive oil is burned in the near term (see 2032 ISO EPCET analysis). **A 4.5% increase in energy due to heating (about the same as the Heat Pump Accelerator Program) increases the LSEEE energy 53% from $3B to $4.6B a 12 times multiplier.**

D. In the longer term 2050, EPCET modeling shows that electrification (heat pumps plus electric vehicles) increases wholesale electic prices 2.3 times because **the marginal cost of HP/EV is 4.3 times the base load**. (ISO-NE has only analyzed HP by itself for 2032. The 2040 and 2050 analyses combine HP+EV. HP has much more expensive characteristics than EV so the 2050 HP only scenario marginal cost is much higher than 4.3 times. (HP has one third the load factor of EV. HP only occcurs at the most expensive time of the year.)

E. In 2050, solar is not effective in winter so expenive offshore wind is built. **90% of the expensive, controversial offshore wind is not needed without HP/EV electrification (EPCET).**

F. Heating load is largely responsible for the low capacity factor of the nuclear SMR units. In the reference scenario the SMR capacity factor decreases from ~50% in 2040 to 14-21% (depending on weather year) in 2050. **The low capacity factor increases the effective price per MWH 1.8 to 6 times over a nuclear unit running at the normal 93% capacity factor.**

See my input to the CT 2025 IRP of last year for more infomation. My summary of how to improve affordability: "*Don't electrify, especially heating*".

Q. How does the marginal generation cost compare to the marginal distribution revenue increases under rate 1 and rate 6?

A. For the 4.5% increase in MWH due to heating in the EPCET 2032 scenario, I calculate **a $320M annual increase in generation costs**. This is CL&P's share for 900 M kWh of heat pump load. In the EPCET presentation of October 18, 2023, LSEEE increased $1.6B and Connecticut's share is about $400M and CL&P is 80% of that or $320 M

Under **Rate 1 the marginal revenue** would be 900 M kWh times .1685 or **$145 M** per year or 45% of the increased generation costs.

Under the **new heat pump Rate 6,** I estimate a marginal increase in revenue **of $96M** or 30% of the increased generation costs. This is the sum of $104M new heat pump revenue (900 M kWh at .11506), a loss on non-heat revenue of about $25M, and a gain of $17 M on the larger customer charges.

I don't guarantee these numbers due to changes in costs and my quick attempt to understand Rate 6 parameters and appropriate volumes. It should be considered a talking point to start the discussion.

The above evaluation is based on short term eg 2032 energy costs and doesn't address new generation required for load growth. New Generation should be addressed in the Comprehensive IRP.

The increase in generation cost clearly dominates the additional distribution revenue and Eversource's call for a Comprehensive IRP and additional gas capacity and possibly peaking plants is the right one.

Q. How do you compare cost of customer heating options?

A. I presented the following graph (Figure 2) of relative heating cost in the DEEP heat pump meeting of May 2024 for the purpose of defining targets for conversion to heat pumps. I recommended that only electric resistance heating and hot water heating be converted to heat pumps. Heat pumps would cost 70% more than a 95% efficient modern gas boiler. For others I suggested that upgrading to more efficient boilers may be more economic especially considering the cold weather heat pump cost issues.

I have added the costs for rate 6 at both a COP of 2.0 and 6.0. I have also added $5.50/gal fuel costs for both new and old inefficient boilers. I don't see where the ~15% reduction due to the new rates will be a large driver of heat pumps, but every bit helps.

I didn't see any market research or analysis to determine if Rate 6 is needed to drive the installation of heat pumps. But the decision may be more driven by reasons other than energy savings: It may be new construction, the old boiler may be failing, or central air conditioning may be desired to which heating capability can often be added at low marginal cost.

There are a large number of heat pumps being installed, so perhaps distribution incentives are not needed. Maine has installed 130,000 and plans to install 130,000 more, Massachusetts has installed 140,000 with a $10-16K conversion subsidy and plans to install 400,000 more (but also now has a 7 c/kWh T&D discount). CT also has a program. There is also a $450M federally-funded Heat Pump Accelerator Program that plans to install 540,000 heat pumps. I hope these are being tracked along with their performance characteristics and backup especially if is natural gas or electricity.

With heating oil at $5.50 per gallon all cold weather heat pumps at any electricity rate beats fuel oil (see figure 2). Friends who previously switched to oil at 32 degrees F are now planning to use the heat pump to 5 degrees or less creating the concern of an unplanned electric demand spike.

Q. Do you see any compelling cases for conversion?

A. Yes. The most compelling conversion is the one we made: Converting an old inefficient oil burner to a 95% efficient natural gas boiler. It reduced our annual heating cost from $3800 per year to $1300. It paid for itself in 4 years and did not require any subsidies. It reduced CO2 50% and didn't transfer the problem to the grid where it may never be solved as the heating spike load will likely always be served by emitting generation. The ISO 2024 Economic Study shows 2050 grid emissions being higher than in 2024 for winter months. (But overall emissions at the end user decrease).

Of course gas pipelines to rural areas are expensive, but I suspect gas supply is still affordable in concentrated urban and suburban areas especially for new developments including large apartment complexes which do not require tearing up the streets.

Q. Are there any public safety concerns with heat pumps?

A. Yes. My gas supply and gas boiler are very reliable unlike the electricity supply (which has improved in recent years). Safety of the family is paramount (including two 90+ year old moms), and I will not give up my gas service at any price.

Our gas furnace can be easily run with a small portable 2.2 kW inverter generator in the event of a power outage. A heat pump system for our home would require a large stationary 20+ kW generator which most families won't install leading to major public safety concerns during an extended power outage.

246 officially died (700+ unofficial count) in the Texas incident a few years ago as I was reminded by one of the heat pump submittals in this docket.

Q. What about comfort concerns?

A. At the legislative hearings 2 years ago, two people testified that there were a large number of propane backup systems installed due to inability of the HP systems to provide adequate heat. I assume these were not the best cold weather heat pumps, but I don't know. One trailer in Maine that installed a heat pump and was forced to remove the legacy system is suing the supplier according to Canary media. There were problems with systems icing during last year's snow and cold spell. The paper below notes that the best air source systems stop working at -13 degrees F a temperature in the historical record for Boston….and frequent in Vermont.

Q. References?

A. Eversource has provided 42 attachments to CLF-011 on the subject of heat pumps many which concern the ability of heat pumps and the electric system to handle the cold spell issue. I note the attachment 15 paper by Spencer and Wirtshafter. Points made:

A. We don't currently value winter peak impacts of full electrification.
B. Flat costs of electricity do not reflect actual grid economics now or in the future. We expect our utilities to keep power available especially at times of extreme weather. To do so they must construct and maintain adequate capacity that will be used quite infrequently.
C. More insulation
D. Understand heat pump performance better.
E. Don't rush. Plan.

My bottom line view: Much less affordable

Figure 2. Graph of Relative Heating Cost Considering Energy Price and Conversion Efficiency for Connecticut

(Equivalent
$ /million BTU)
|
$83 Electric resistance heat (100% efficient) (Also oil old boiler 60% eff at 6.90 per gallon)
|
|
|
|
$68 Propane (old boilers, 60% efficient)
|$66**********OLD BOILER 60% EFFICIENT $5.50 OIL
|
|
|
$53**Heat Pump (200% at 5 deg F at Winter Gen Cost of 20 c/kWh

$47**********NEW BOILER 85% EFFICIENT $5.50 OIL
$43 Propane (new boilers, 95% efficient)
$42 Oil (old boilers, 60% efficient)
$41********Heat Pump (200% efficient at 5 degrees F) Today's Elec Price**
$35********Heat Pump (300%) Today's Winter Gen Cost Of 20c/kWh**
$35----------Heat Pump (200% 5 deg) RATE 6
$30 Oil (new boilers, 85% efficient)
$28********Heat Pump (300%) Today's Electric Prices (Gen 12c/kWh)**
$25 Natural Gas (old boilers, 60% efficient)
$23----------Heat Pump (300% avg) RATE 6
|
$16 Natural Gas (new boilers, 95% efficient)
|

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For Eversource rate case delivered price is 28.381 c/kWh = 16.185 + 12.196 gen
For Rate 6 heat pump rate delivered price is 23.7 c/kWh = 11.5 +12.196 gen

Winter Costs from actual generation bids are about 20 c/kWh per Eversource testimony on 2025 CT IRP. Jan 2026 wholesale price was 20 c/kWh which implies a retail price of about 25 c/kWh. I stayed with 20 cents as it represents an average winter price.

Other prices used in above (from 2 years ago):

Natural gas(CNG)	15 $/MMBtu
Propane	3.75 $/gallon
Oil	3.50 $/gallon

Heat Pump Efficiency updated to 200% at 5 deg F as Energy Star is now 175% at 5 degrees and many are better.