SENT VIA E-Mail and FedEX

June 30, 2022

Melanie Bachman
Executive Director
Connecticut Siting CouncilC
Ten Franklin Square
New Britain, CT 06051

Re: **LIFE-CYCLE 2017 –** Connecticut Siting Council Investigation into Life-Cycle Costs of Electric Transmission Lines.

Dear Ms. Bachman:

Please find enclosed the original and sixteen (16) copies of The United Illuminating Company's ("UI") responses to the Connecticut Siting Council's ("CSC") first set of interrogatories regarding the Investigation into Life-Cycle Costs of Electric Transmission Lines, dated May 16, 2022. Additionally, UI will electronically file all responses and attachments electronically via siting.council@ct.gov.

Respectfully submitted,

THE UNITED ILLUMINATING COMPANY

By: _____
Leonard Rodriguez
General Counsel

Enclosures

cc: James Cole (via email)
Meena Sazanowicz (via email)
Jim Yeske (via email)

Q-CSC-I-1: For new overhead transmission line installations in Connecticut, what transmission structure designs, including structure material and conductor arrangement (i.e. single-circuit vertical steel monopole), are mostly commonly used and for what reason(s)?

A-CSC-I-1: For new overhead transmission line installations in Connecticut, UI most commonly utilizes single-circuit delta, and double circuit vertical configuration installed on tubular steel poles. The delta configuration allows for optimal height and width for the supporting structures subject to availability of land / easements. However, UI's recent transmission line construction has occurred only along the Metro North corridor and due to the right of way constraints inherent in work along the rail corridor, UI has primarily utilized a vertical conductor configuration. Double circuit configuration was selected for the new transmission line design along the Metro North corridor since there weren't any transmission planning constraints for these line sections, as was the case in previous projects, and this configuration was determined to be the lowest cost solution.

Tubular steel poles are UI's preferred structure for the following reasons:

1) Their known mechanical strength
2) Durability over 40 years of life
3) Availability through numerous domestic vendors

Q-CSC-I-2: What structure designs, including structure material and conductor arrangements, are no longer used and for what reason(s)?

A-CSC-I-2: Lattice steel structures are no longer used on UI's transmission system for new construction. The main reasons lattice steel structures are no longer used include: appearance, the larger amount of real estate required for their installation; and being prone to climbing, trespassing and vandalism. Improvements in tubular pole design and manufacturing has contributed towards increased popularity of tubular poles at UI. However If the situation dictated using a lattice tower, due to cost or structural requirements, we would consider using such structure(s).

UI utilizes various conductor configurations (horizontal, vertical and delta) and the configuration selected is the one that provide the best solution for a specific application.

Q-CSC-I-3: Of the overhead configurations listed in response to Question 1, what configurations would UI consider prudent for life cycle analysis? Please complete the table provided with current first cost per circuit mile and losses for each of the noted configurations.

A-CSC-I-3: The following costs and losses are based on actual construction costs of single circuit vertical steel pole configuration using 1590 ACSS conductor along Metro North Railroad right of way.

	First Costs per Circuit Mile		Losses
Poles & Foundations	$1,461,542	Conductor Size & Type	1590 ACSS
Conductor & Hardware	$183,304	Resistance	.0622 ohm/mile
Site Work	$2,351,990	Peak Line Current	2148 A (428 MVA)
Construction	$3,627,148	Load Growth	.61%
Engineering	$1,430,839	Loss Factor	.35
Sales Tax	$48,451	Energy Cost	44.66 $/MWh
Project Management	$569,124	Energy Cost Escalation	-0.29%
UI's Costs	$1,147,095		
Total Cost	**$10,819,493**		

Q-CSC-I-4: Complete the table provided with current first cost per circuit mile and losses for each of the following overhead electric transmission line configurations, if not already addressed in Question 3:

a) 115 kilovolt (kV) wood H-frame
b) 115 kV steel delta
c) 345 kV wood H-frame
d) 345 kV steel delta

First Costs		**Losses**	
Poles & Foundations		Conductor Size & Type	
Conductor & Hardware		Resistance	
Site Work		Peak Line Current	
Construction		Load Growth	
Engineering		Loss Factor	
Sales Tax		Energy Cost	
Project Management		Energy Cost Escalation	

A-CSC-I-4:

a) UI has not constructed any 115 kV wood H-frame structures since our last response in 2017.

b) See CSC-I-3 response

c) UI has not constructed any wood 345 kV H-frame structures since our last response in 2017.

d) UI has not constructed any 345 kV delta structures since our last response in 2017.

Interrogatory CSC-I-5

Q-CSC-I-5: What type of conductors does UI typically install for new overhead transmission lines? Why was this conductor type selected?

A-CSC-I-5: Conductor selection for new designs is based upon ampacity requirements for the circuit(s) being designed. The conductor that is most typically installed in UI's new designs is ACSS. This is because of its low sag and high temperature characteristics. UI is using ACSS conductors on a majority of its projects that are currently in design and/or were recently constructed.

Interrogatory CSC-I-6

Q-CSC-I-6: What is the expected design life of an overhead transmission line?

A-CSC-I-6: UI anticipates a minimum 40-year design life.

Interrogatory CSC-I-7

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Q-CSC-I-7: For variables listed under Losses in Questions 3 and 4, provide the origin of the value. Is the Loss Factor constant or does it vary over the life cycle period?

A-CSC-I-7: The origin of UI losses in question 3 are attached as Appendix 1 titled “UI Question 3 – “Losses” Reference Material”. The Loss Factor will vary over time because it is dependent on system loading patterns which vary from year to year.

Q-CSC-I-8: Provide costs per circuit mile of the past five years for operation and maintenance of UI's existing overhead transmission lines in accordance with Federal Energy Regulatory Commission (FERC) Accounts 560, 563, 564, 568, 571, and 572

A-CSC-I-8: Costs per circuit mile of the past five years for operation and maintenance (O&M) of UI's existing overhead transmission lines in accordance with Federal Energy Regulatory Commission (FERC) Accounts 560, 563, 564, 568, 571, and 572 are as follows:

	2017	2018	2019	2020	2021
Costs per circuit mile for O&M of UI's existing overhead transmission lines of 109.6 miles	$43,876	$45,298	$42,770	$40,129	$20,691

Interrogatory CSC-I-9

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Witness: K. Kleza

Q-CSC-I-9: Provide costs per mile of the past five years for UI's vegetation management activities for transmission line rights-of-way. What FERC Account is UI's vegetative management cost assigned to?

A-CSC-I-9: UI Transmission Vegetation Management metrics track completed cycle maintenance miles only. Annual costs below also include UI's costs incurred by Metro North Railroad and Federal Rail Administration (Amtrak) personnel in support of UI's vegetation management work and non-cycle vegetation management work performed throughout the year for right-of-way (ROW) reclamation, LiDAR (Light Detection and Ranging) identified reliability work, off-ROW fall-in risk mitigation, etc.

The transmission portion of vegetation management costs primarily post to FERC account 560.

Years	2017	2018	2019	2020	2021
Cycle Miles Completed	12.5	27.3	21.4	16.4	14.89
Total Annual Cost	$1,670,347	$1,378,859	$1,521,449	$1,520,908	$1,338,284
Cost per ROW mile (cost/completed miles)	$133,628	$50,508	$71,096	$92,738	$89,878
Cost per ROW mile (cost/territory miles)	$21,144	$17,454	$19,259	$19,252	$16,940

Q-CSC-I-10: Provide the rationale of including or not including the following overhead transmission line configurations:

a) Lattice structures;
b) Laminate structures; and
c) Vertical conductor design.

A-CSC-I-10:

a) UI no longer uses lattice structures for new construction. As stated in the response to interrogatory Q-CSC-I-2, the reason they are no longer used for new construction: They require large amount of real estate which is hard to find in an urban environment like that of UI's territory. They are prone to climbing, trespassing and vandalism. Preference is being given to other structure types i.e. tubular steel pole as the technology has improved over the years due to extensive use of computerized designing and better manufacturing processes; however, lattice type may find their use at UHV i.e. 765 kV levels, in rural areas or under special design considerations.

b) UI does not use laminate structures for new construction. UI has only one wood pole line which utilizes traditional wood poles. The wood poles are direct buried and subject to rot, bird and insect damage. Wood poles (laminated or non-laminated) may be used in certain situations like temporary construction or at by-passes. Further, laminated structures are much more expensive than regular wood poles and are approaching the cost of steel poles.

c) UI will implement vertical conductor design for the majority of its new line designs, since structure designs are double circuit construction. UI is presently using this design on its Metro North (MN) Railroad (RR), and Ansonia to Derby Rebuild Projects currently in design.

Q-CSC-I-11: For new underground transmission line installations in Connecticut, what underground transmission designs, including cable type and arrangement (e.g. single-circuit horizontal XLPE), are most commonly used and for what reason(s)?

A-CSC-I-11: For new underground transmission line designs UI has typically used a vertical configuration (i.e. three ducts across by four ducts down). This is to enable the duct bank to fit within the limited and narrow available space within the roadways. A flat or horizontal design may be warranted where there is space and for underground crossings or when rising out of the ground to the cable terminations.

Interrogatory CSC-I-12

Q-CSC-I-12: Which underground transmission line designs, including cable type and arrangements, are no longer used and for what reason(s)?

A-CSC-I-12: For design and construction of new transmission lines, UI no longer utilizes high pressure pipe type or low-pressure self-contained cable systems. This is due to both environmental factors pertaining to the dielectrics used in these systems as well as limited resources for both materials and the specialized labor needed to construct and maintain these systems.

Q-CSC-I-13: Of the underground configurations listed in response to Question 11, what configurations would UI consider prudent for life cycle analysis? Please complete the table provided with current first cost per linear mile and losses for each of the noted configurations. Include information for both a single circuit and double circuit transmission line design.

First Costs		**Losses**	
Ducts & Vaults		Cable Size & Type	
Cable & Hardware		Resistance (ohms/mile per conductor)	
Site Work		Number of Conductors Per Phase	
Construction		Peak Line Current (amps)	
Engineering		Annual Load Growth (%)	
Sales Tax		Loss Factor	
Project Management		Energy Cost ($/MWh)	
		Annual Energy Cost Escalation (%)	

A-CSC-I-13: UI has not constructed any cross-linked polyethylene (XLPE) transmission lines since our last response in 2017.

Q-CSC-I-14: Complete the table provided with first cost per linear mile and losses for each of the following underground electric transmission line configurations if not already addressed in Question 13:

a) 115 kV high pressure fluid filled (HPFF) pipe
b) 345 kV HPFF
c) 115 kV cross-linked polyethelene (XLPE)
d) 345 kV XLPE

First Costs		**Losses**	
Ducts & Vaults		Cable Size & Type	
Cable & Hardware		Resistance (ohms/mile per conductor)	
Site Work		Number of Conductors Per Phase	
Construction		Peak Line Current (amps)	
Engineering		Annual Load Growth (%)	
Sales Tax		Loss Factor	
Project Management		Energy Cost ($/MWh)	
		Annual Energy Cost Escalation (%)	

A-CSC-I-14:

a) UI has not constructed any 115 kV high pressure fluid filled (HPFF) transmission lines since our last response in 2017.

b) UI has not constructed any 345 kV HPFF transmission lines since our last response in 2017.

c) UI has not constructed any 115 kV cross-linked polyethylene (XLPE) transmission lines since our last response in 2017.

d) UI has not constructed any 345 kV XLPE transmission lines since our last response in 2017.

Interrogatory CSC-I-15

Q-CSC-I-15: Do First Costs for HPFF transmission include fluid pumping and cooling equipment

A-CSC-I-15: Yes. First Costs for any fluid pumping and/or cooling equipment are included in the design and construction of an HPFF system.

Q-CSC-I-16: For variables listed under Losses in Questions 13 and 14, provide the origin of the value. Is the Loss Factor constant or does it vary over the life cycle period?

A-CSC-I-16: As stated in the response to Questions 13 and 14, UI has not constructed any such transmission cables our last response in 2017. Therefore, no loss factor calculations were performed.

Interrogatory CSC-I-17

Q-CSC-I-17: What is the expected design life of an underground transmission line?

A-CSC-I-17: We assume a minimum 40-year design life.

Q-CSC-I-18: Provide costs per circuit mile of the past five years for operation and maintenance of UI's existing underground transmission lines in accordance with FERC Accounts 560, 563, 564, 568, 571, and 572.

A-CSC-I-18: Costs per circuit mile of the past five years for operation and maintenance (O&M) of UI's existing underground transmission lines in accordance with FERC Accounts 560, 563, 564, 568, 571, and 572 are as follows:

	2017	2018	2019	2020	2021
Costs per circuit mile for O&M of UI's existing underground transmission lines of 28.8 miles	$41,641	$42,945	$40,854	$36,679	$10,387

Interrogatory CSC-I-19

Q-CSC-I-19: What type of conductors does UI typically install for new underground transmission lines? Why was this conductor type selected?

A-CSC-I-19: For new design and construction, UI utilizes cross-linked polyethylene (XLPE) type cables. This is due to the limited material manufacturers and specialized construction contractors in the industry for the other cable system types (i.e. high- and low-pressure cable systems). XLPE type cable systems also have less environmental and maintenance risks related to dielectric fluid leaks.

Interrogatory CSC-I-20

Q-CSC-I-20: Provide the following variables for cost calculations including the origin of the value:

a) Capital recovery factor;
b) Annual Operation and maintenance cost escalation rate as a percent; and
c) Discount rate.

A-CSC-I-20:

a) The capital recovery factor is 10.79% per the Cost of Capital Rate calculated in the 2021 Regional Network Service Transmission Revenue Requirement.

b) The operation and maintenance cost escalation rate is 1.4% for general inflation and outside services per UIL's corporate accounting budgeting guidelines.

c) The discount rate is not applicable.

Q-CSC-I-21: Provide information regarding existing transmission facilities by length, voltage, construction type, and single/double circuit installation.

A-CSC-I-21: The Company's transmission lines by voltage, construction type, single or double circuit (including circuit miles) are shown on Appendix 2, titled "UI Transmission Facilities – Breakdown".

Q-CSC-I-22: List all relevant standards applicable to 115kV and/or 345kV transmission resources for the following categories:

a. Reliability;
b. Security;
c. Vegetation Management, and
d. Storm hardening.

A-CSC-I-22:

The following are all relevant standards applicable to transmission resources:

a) The following reliability criteria are followed: NERC TPL, NPCC Directory 1, ISO-NE PP3 and Avangrid Planning Criteria.

b) UI does not have any knowledge of transmission line security standards except the need for "Signage" on all structures per the National Electric Safety Code ("NESC").

c) NERC FAC-003-4; and UI OP-T70, Transmission Vegetation Management Program procedure are the standards applicable to vegetation management. These are applicable to both 115kV and 345kV lines.

UI standards for storm hardening call for designing its overhead transmission facilities in accordance with current NESC and to the level of a category III hurricane and 1 ½ inch of radial ice. This is applicable to UI's newer lines only. There is no difference between the 115 kV and 345 kV systems in terms of structural loading conditions.

Interrogatory CSC-I-23

Q-CSC-I-23: Have the National Electric Safety Code and/or the State of Connecticut Building Code been updated within the last five years? If yes, would the updated codes impact life cycle costs? Identify code changes that significantly increase life cycle costs.

A-CSC-I-23: There have been no updates to the NESC code since our last response in 2017. The State of Connecticut Building Code does not apply to overhead or underground transmission lines.

Interrogatory CSC-I-24

Q-CSC-I-24: List federal and state permits and registrations that may be required to a construct a transmission line in Connecticut. How are such permits/registrations accounted for in first costs and life cycle costs?

A-CSC-I-24: The following federal and state permits and registrations may be required to construct a transmission line in Connecticut:

Federal

- Army Corp of Engineers
  - Self-Verification Form ("SVF")- Impacts to resource areas outlined under impact specific General Permit(s) within Connecticut Programmatic General Permit
  - Pre-Construction Notification ("PCN")- Impacts to resource areas outlined under impact specific General Permit(s) within Connecticut Programmatic General Permit ("CT PGP")
  - Individual Permit – Large scale impacts not covered under SVF or PCN General Permits in CT PGP
  - Section 106 Review – Based on potential impacts to Historical Properties under State Historic Preservation Office, Tribal Historical Preservation Office or National Register of Historic Places
- US Fish & Wildlife
  - Northern Long-Eared Bat Review – Based on Federal nexus and potential impacts to hibernacula and roosting trees
  - IPac Sensitive Species Review

State

- Connecticut Department of Energy & and Environmental Protection
  - Section 401 Water Quality Certification – Related to inland impacts, filters up to ACOE SVF or PCN
  - Structure Dredge and Fill: Certificate of Permission – Impacts to Tidal resources
  - Structure Dredge and Fill: Individual Permit – Type or quantity of impacts to tidal impacts
  - NDDB Project Review Form – Projects with impacts within polygon
  - Stormwater Pollution Control Plan & Registration Under CT DEEP General Permit Projects with >1 acre of temporary construction footprint will need to register and generate SWPCP
  - Groundwater Remediation Directly to Surface Water – Groundwater management based on characterization of groundwater and municipal acceptance. More appropriate for Urban/Industrial-Commercial settings
  - Groundwater Remediation Directly to a Sanitary Sewer – Groundwater management based on characterization of groundwater. More appropriate for Urban/Industrial-Commercial settings

- State Historic Preservation Office
    - Project Notification and Review forms

All costs associated with revised or prevailing standards and environmental permits are incorporated in the Engineering costs.

Interrogatory CSC-I-25

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Q-CSC-I-25: Does UI anticipate constructing new transmission lines that operate only at 69-kV or 138-kV within the next 5 years. If yes, in what locations and for what reasons?

A-CSC-I-25: No. UI does not anticipate constructing any new transmission lines that operate only at 69-kV or 138-kV within the next 5 years.

Q-CSC-I-26: Describe how leak prevention and containment measures used for HPFF cable systems could impact life-cycle costs.

A-CSC-I-26: Presently UI monitors fluid pressures, fluid flows and pump-run characteristics continuously. Leaks are detected by rapid pressure variations and excessive pump operation. The system is monitored continuously by Supervisory Control and Data Acquisition (SCADA). This type of monitoring obviates the need for repeated patrols and manual data review by Operation's personnel, thereby reducing O&M costs. The costs for this system were incorporated in the overall cost of the pumping plants.

Interrogatory CSC-I-27

Q-CSC-I-27: Has UI experienced, in the last five years, issues with construction or maintenance of overhead or underground transmission lines in locations that required special processes or procedures due to environmental sensitivity? If so, please describe the situations and the cost impacts.

A-CSC-I-27: In the last five years, UI has experienced issues with environmental sensitivities in mainly two areas.

Soil Management

Given that many of UI transmission projects are within areas with highly urbanized historic land use, soils from foundation excavations must be environmentally pre-characterized and carefully managed to ensure appropriate management and/or disposal. In some cases, UI has had to place monopoles within areas where a protective environmental cap (Engineered Control) has been placed over certain soil conditions. These unique cases take significant advance planning and site-specific execution do in conjunction with the site owner to ensure the functional integrity of the Engineered Control.

Ecological Sensitivities

On most UI projects there are ecological sensitivities such as wetlands habitats or the presence of a nearby unique plant or animal species. Mitigation processes include designs to eliminate or minimize impacts, special matting of access paths to avoid habitat disturbance, barriers to prevent turtle species from entering work areas and block out schedule windows where certain activities are limited or prohibited to avoid impacts to sensitive species at crucial times.

All costs associated with environmental sensitivities and permits are incorporated in the Engineering costs.

Q-CSC-I-28: ISO-New England (ISO-NE) has issued planning and operating standards for design and operation of transmission facilities. One standard prescribes transmission line ratings for normal conditions, short-term emergency and long-term emergency conditions. Does UI expect the standards to impact transmission line life-cycle costs, and if so, to what extent?

A-CSC-I-28: No, UI does not anticipate the ISO-NE planning and operating standards for design and operation of transmission facilities to impact transmission line life-cycle costs.

Interrogatory CSC-I-29

Q-CSC-I-29: Has UI identified other ISO-NE policies or operating procedures that are anticipated to impact transmission line life-cycle costs? If so, what are they and what is the anticipated impact?

A-CSC-I-29: No, UI has not identified other ISO-NE policies or operating procedures that are anticipated to impact transmission life cycle costs.

Q-CSC-I-30: Under what conditions would UI consider using high voltage direct current (HVDC) lines for long-distance power transfers? How would the life cycle costs of HVDC lines compare to high voltage alternating current (HVAC) transmission lines?

A-CSC-I-30: UI does not anticipate using HVDC lines for long-distance power transfers in the foreseeable future.

Q-CSC-I-31: Are UI's transmission line capital and construction costs higher, on par, or lower than other Northeast Power Coordinating Council region utilities? If higher or lower, by what percentage and perceived reason?

A-CSC-I-31: In general, UI believes that its transmission line capital and construction costs are on par with other Northeast Power Coordinating Council region utilities except along the congested and densely populated Metro North Railroad Corridor. Work along the railroad corridor tends to be more complex and costly per mile when compared to similar work in a rural area for reasons that include the following:

1) Narrow and congested ROW
2) Limited construction outage availability (i.e. commuter train schedule restrictions)
3) Railroad resources required for all construction (i.e. flagmen, groundmen)

Q-CSC-I-32: Are UI's transmission line operation and maintenance costs higher, on par, or lower than other Northeast Power Coordinating Council region utilities? If higher or lower, by what percentage and perceived reason?

A-CSC-I-32: UI believes its transmission line operation and maintenance costs are higher than other Northeast Power Coordination Council region utilities. Two major factors are Metro-North Rail, and Reclamation.

48 miles, or nearly half, of UI's Transmission lines run along Metro-North Rail catenaries. In order to perform vegetation management along the rail corridor, UI is required by the Federal Rail Administration to secure a 5-year permit ($5,500) and a daily Metro-North safety flagger (up to $2,000/day). Also, for any vegetation within 10 feet of an energized Metro-North conductor, an outage must be scheduled, requiring two Metro North groundmen at a cost of up to $2,000/day each.

Right-of-way reclamation is an ongoing project following implementation of NERC regulations. The goal of reclamation is to fully clear the right-of-way to its full width for maintenance and reliability purposes and to increase the area maintainable by selective foliar herbicide treatment. While crews are on site for routine cycle maintenance, ROWs such as Metro North, which have difficult access, are also being reclaimed each time through. Approximately 3 trees are being removed for every 1 tree that could be pruned during cycle maintenance in a fully reclaimed ROW. Reclamation and LiDAR-based reliability work are also performed outside of cycle maintenance, particularly on NERC-designated critical lines, for risk mitigation, compliance, and increased maintenance efficiency.

Interrogatory CSC-I-33

Q-CSC-I-33: What policies and/or methods could be implemented to reduce or offset life-cycle costs of transmission lines?

A-CSC-I-33: The following polices and/or methods could be implemented to potentially reduce or offset the life-cycle costs of transmission lines:

- Certain design configurations such as span length optimization (i.e. longer spans, less poles, equipment)
- Review of current material installations, such as wood for transmission, and standardizing on other material options with potentially less associated O&M costs (light duty steel, composite, ductile iron, etc). The UI standards team is already reviewing these other options.
- "Right sizing" transmission equipment for long-term forecasts (i.e. 20-30 years) so that service life can be maximized. FERC issued a NOPR recently addressing this concept.
- Use of new technologies for ROW inspections such as drones that would eliminate or drastically reduce the need for outages for climbing inspections, or the physically climbing the structures.

Q-CSC-I-34: Does UI have a telecommunications antenna attachment policy for overhead transmission line structures? If so, what is the policy

A-CSC-I-34: UI does not currently have a telecommunications antenna attachment policy for overhead transmission line structures.

Appendix 1

UI Question 3 – Losses Reference Material

CSC Life-Cycle 2022
UI Question 3 - "Losses" Reference Material

Resistance

Reference Value	Resistance (Ohms)	Mileage	Per/Mile Resistance	Comments
88005A-2 (Milvon - Devon Tie) 1590 ACSS	0.0854	1.3730	***0.0622***	ISO-NE NX-9 Database

Peak Line Current

Reference Value	Peak Line Current *(Normal Rating)*		Comments
	MVA	Amps	
88005A-2 (Milvon - Devon Tie) 1590 ACSS	428	2148	ISO-NE NX-9 - (88005A-2 Line) Assumes summer normal thermal rating

Load Growth (CAGR)

Reference Value	Peak Load Forecast[1] *(50/50 w/ BTM PV and EE reduction)*		CAGR	Comments
	2021	2031		
ISO-NE 2017 CELT Forecast (May 1, 2017)	23,822	25,322	***0.61%***	*CAGR = (Ending Load/Beginning Load)^(1/#yrs.) -1*

Loss Factor

Loss Factor = (0.3 x Load Factor) + (0.7)*(Load Factor)^2 -- [2]
Load Factor = Average Load/Peak Load

Reference Value	2021 Average Load[4] *(Actual)*	2021 Peak Load[5] *(Actual)*	Load Factor	Loss Factor	Comments
ISO-NE 2017 CELT Forecast & "2021 SMD Hourly Data"[3]	13,556	25,801	***0.53***	***0.35***	--

Energy Cost

Reference Value	2021 avg. Real-Time Energy Costs *(CT Load Zone)* ***$/MWh***		Comments
	Energy (EC) Component (LMP)	Loss (MLC) Component (LMP)	
"2021 SMD Hourly Data"[6]	$44.66	-$0.74	--

Energy Cost Escalation

Reference Value	2016 avg. Real-Time Energy Costs *(CT Load Zone)* ***$/MWh***			Escalation[7] *(2015 - 2021)*	Comments
	Year	Energy (EC) Component (LMP)	% Change		
SMD Hourly Data[6]	2015	$40.77	--	***-0.29%***	These data represent the energy cost component of CT LMP zonal pricing over a 6 year period (2015 - 2021)
	2016	$28.97	***-28.94%***		
	2017	$33.73	***16.43%***		
	2018	$43.21	***28.11%***		
	2019	$30.56	***-29.28%***		
	2020	$23.30	***-23.76%***		
	2021	$44.66	***91.67%***		

Note(s):

1) ISO-NE 2022 CELT Forecast - Load value represents 50/50 NE peak load net of Behind the meter PV and EE *(https://www.iso-ne.com/system-planning/system-plans-studies/celt)* - Reference Tab 1.1 Summer Peak
2) Depazo et al "An optimization technique for real and reactive power allocation, Proc. IEEE. Nov, 1967. http://www.arpapress.com/Volumes/Vol12Issue2/IJRRAS_12_2_20.pdf
3) "2021 SMD Hourly Data" lists hour ending ISO-NE load data for 2021 *(https://www.iso-ne.com/isoexpress/web/reports/load-and-demand/-/tree/zone-info)*
4) "2021 SMD Hourly Data" - Average "System_Load" located in the "ISO-NE CA" Tab
5) ISO-NE 2022 CELT Forecast - Reference Tab 1.5.1 "Peak Loads" June 2021 *(Reduced for BTM PV and PDR)*
6) Average hour ending ISO-NE/CT LMP data for each year *(https://iso-ne.com/isoexpress/web/reports/pricing/-/tree/zone-info)*
7) Calculated via linear regression and compared to 7-year average LMPs

Legend
Calculated Values

Appendix 2

UI Transmission Facilities Breakdown

	UI Transmission Facilities - Breakdown						
Desegnation		Voltage (kV)	Structure Type *(Overhead-OH) (Underground-UG)*	Circuit Type	Length (Circuit Miles) *ISO-NE NX-9 Data, 06/23/2022*		
Line Number	Terminals (From - To)				UI Circuit (Total)	UI OH	UI UG
1130	Pequonnock -> Compo (ES Owned)	115	OH - Metal Tower	Single	6.8	6.8	0.0
1430	Ash Creek -> Sasco Creek	115	OH - CAT Tower	Single	4.0	4.0	0.0
1460	East Shore -> Branford RR (ES Owned)	115	OH - Steel Pole	Double	3.0	3.0	0.0
1537	Branford RR (ES Owned) -> Branford (ES Owned)	115	OH - Steel Pole	Double	2.9	2.9	0.0
1560	Pootatuck -> Stevenson (ES Owned) -> Ansonia	115	OH - Metal Tower	Double	3.9	3.9	0.0
1570	Devon (ES Owned) -> Indian Well -> Beacon Falls	115	OH - Metal Tower	Double	1.4	1.4	0.0
1594	Ansonia -> Indian Well	115	OH - Metal Tower	Double	2.5	2.5	0.0
1610	June St -> Mix Ave -> Southington (Glen Lake - Mix)	115	OH - H Frame (Wood)/Steel Pole	Single/Double	3.6	3.6	0.0
1630	North Haven -> Walrec Tap	115	OH - Steel Pole	Double	1.7	1.7	0.0
1655	North Haven -> Branford (ES Owned)	115	OH - Steel Pole	Double	1.7	1.7	0.0
1685	June St -> Devon (ES Owned)	115	OH - Steel Pole	Double	0.8	0.8	0.0
1714	Trumbull -> Weston (ES Owned)	115	OH	Double	0.0	0.0	0.0
1730	Trumbull -> Devon (ES Owned)	115	OH	Double	0.0	0.0	0.0
1780	Devon Tie -> Devon (ES Owned)	115	OH - Metal Tower	Double	0.1	0.1	0.0
1790	Devon Tie -> Devon (ES Owned)	115	OH - Metal Tower	Double	0.1	0.1	0.0
8100	East Shore -> Grand Ave	115	OH - Steel Pole	Double	1.6	1.6	0.0
8200	East Shore -> Grand Ave	115	OH - Steel Pole	Double	1.6	1.6	0.0
8300	Grand Ave -> Quinnipiac	115	OH - Steel Pole	Double	2.3	2.3	0.0
8301	Grand Ave -> Mill River	115	OH - Steel Pole	Single	0.0	0.0	0.0
8400	Grand Ave -> Sackett	115	OH - Steel Pole	Double	4.3	4.3	0.0
8600	North Haven -> Quinnipiac	115	OH - Steel Pole	Double/Single	8.1	8.1	0.0
91001	Pequonnock -> Ash Creek -> Bridgeport Resco	115	OH - CAT Tower	Single	3.6	3.6	0.0
88005A	Devon Tie -> Milvon -> Woodmont	115	OH-CAT Tower/Steel Pole	Double/Single	5.4	5.4	0.0
88006A	Baird -> Barnum -> Devon Tie	115	OH-Steel Pole	Single	2.6	2.6	0.0
8804A	Allings Crossing -> Woodmont	115	OH-CAT Tower	Double	2.8	2.8	0.0
8809A	Baird -> Congress -> Pequonnock	115	OH-CAT Tower/Steel Pole	Double/Single	3.0	3.0	0.0
89005B	Devon Tie -> Milvon -> Woodmont	115	OH-CAT Tower/Steel Pole	Double/Single	5.4	5.4	0.0
89006B	Baird -> Barnum -> Devon Tie	115	OH-Steel Pole	Single	2.6	2.6	0.0
8904B	Allings Crossing -> Woodmont	115	OH-CAT Tower	Double	2.8	2.8	0.0
8909B	Baird -> Congress -> Pequonnock	115	OH-CAT Tower/Steel Pole	Double/Single	3.1	3.1	0.0
1697	Pequonnock -> Trumbull	115	OH-Metal Tower/UG	Double	5.2	3.8	1.4
1710	Pequonnock -> Devon (ES Owned) -> Old Town	115	OH-Metal Tower/UG	Double	5.2	3.8	1.4
88003A	Grand Ave -> West River -> Elmwest -> Allings Crossing	115	OH-CAT Tower/UG	Double	5.2	2.4	2.8
89003B	Grand Ave -> West River -> Elmwest -> Allings Crossing	115	OH-CAT Tower/UG	Double	5.2	2.4	2.8
1943	Singer -> Bridgeport Energy	115	UG	Single	0.2	0.0	0.2
1955	Pequonnock -> Singer	115	UG	Single	0.4	0.0	0.4
8500	Grand Ave -> Water Street	115	UG	Single	1.5	0.0	1.5
8700	Water Street -> Union Ave	115	UG	Single	0.2	0.0	0.2
8702	Union Ave -> West River	115	UG	Single	1.3	0.0	1.3
9500	Broadway -> Water Street	115	UG	Single	1.6	0.0	1.6
9502	Broadway -> Mill River	115	UG	Single	1.7	0.0	1.7
9550	Grand Ave -> Mill River	115	UG - GIL	Single	0.1	0.0	0.1
84004	Mix Ave -> Sackett	115	UG	Single	2.3	0.0	2.3
387	East Shore -> Halvarsson -> Scovill Rock (ES Owned)	345	OH-Steel Pole/Metal Tower	Double/Single	6.3	6.3	0.0
3216	North Bloomfield (ES Owned) -> Agawam (ES Owned)	345	OH - Steel Pole	Single	3.8	3.8	0.0
3271	Card (ES Owned) -> Lake Road (ES Owned)	345	OH - Steel Pole	Single	4.5	4.5	0.0
3642	Manchester (ES Owned) -> Meekville Jct (ES Owned)	345	OH - Steel Pole	Single	1.1	1.1	0.0
3165	Singer -> East Devon (ES Owned)	345	UG	Double	5.6	0.0	5.6
3619	Singer -> East Devon (ES Owned)	345	UG	Double	5.6	0.0	5.6
				Totals-->	***138.5***	***109.6***	***28.9***