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Subject: **UI SCEF Bridgeport**
Bloom Energy Fuel Cell Project
Airborne Noise Assessment
At 1225 Central Avenue
Bridgeport, CT 06607

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Date: **November 27, 2023**

Revision: **0**

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Summary

This document makes a positive acoustic assessment that should assist in meeting any acoustic noise concerns during the operation of thirteen Bloom 330 KW, 300 KW and 250 KW energy servers at the proposed site at 1225 Central Avenue in Bridgeport, CT. An acoustic assessment plan was developed to acquire airborne acoustic data to explain the potential airborne noise issues during operation of the energy servers. It is important to show that the airborne noise generated by the UI SCEF Bridgeport Bloom Energy Fuel Cell Project will not significantly impact the neighbors or exceed the airborne noise limits in the CT[1] and Bridgeport Ordinances[2].

The airborne noise levels expected to be generated by the Bloom energy servers operating at the Bridgeport site were simulated by exciting a Soundboks speaker at two of the energy server positions at the northern and southern ends. The Soundboks speaker produced an overall airborne noise level that was 33 to 34 dB higher than the levels measured for seventeen Bloom energy servers installed at Bristol, CT (56 dBA at 5 meters[3]).

Airborne noise levels with the speaker operating were measured at distances from 5 to 60 meters from the proposed energy server locations. The speaker produced overall A-weighted sound pressure levels of approximately 89 to 90 dBA at 5 meters and 78 to 84 dBA at 10 meters (reference 20 microPascals) at the proposed north and south energy server locations. The airborne noise levels from the speaker received at nearby properties near the site were measured at noise levels of 68 to 87 dBA. Analysis of the speaker data indicated sound propagation losses of -1.6 to 32 dB from the energy servers' location to the nearby properties. The airborne source level at 5 feet from the operation of the Bloom 62.5 KW energy servers at Bristol, CT was then used as a basis for making the Bridgeport energy server airborne noise estimates. Scaling the 62.5 KW energy servers resulted in a 62 dBA source level for one 330 KW server at 10 feet. Since this was 5 dB lower than the Bloom information[4], the higher 67 dBA level was used.

The closest residential zone is only 80 meters away. Based on the analysis shown in Table 4 the airborne noise from the thirteen new energy servers should be well below the 51 dBA noise limit in the southern residential zone. All other nearby residential properties at greater distances are expected to be well below the day time and night time Residential Zone noise limits for an emitter in an Industrial zone. The closest northern, western and eastern properties are expected to be at least 5 dB below the industrial noise limit of 70 dBA. Operation of the thirteen Bloom energy servers will have no significant acoustic impact to the nearby properties adjacent to the Bloom energy server site at 1225 Central Avenue in Bridgeport.

The Connecticut's Noise Code[1] also calls for review of acoustic issues associated with impulse noise, prominent discrete tones, infrasonic and ultrasonic noise. Operation of the energy servers is expected to meet all of these requirements at all of the nearby property lines. The purpose of this effort is to evaluate the acoustical environment at the Bridgeport sire during operation of the thirteen Bloom 330 KW, 300 KW and 250 KW energy servers. This effort has been accomplished and the results show that the operation of the thirteen Bloom energy servers will meet all of the State of Connecticut and City of Bridgeport airborne noise requirements at all of the nearby properties. Operation of the thirteen Bloom energy servers will have no significant acoustic impact at all the nearby properties.

Introduction

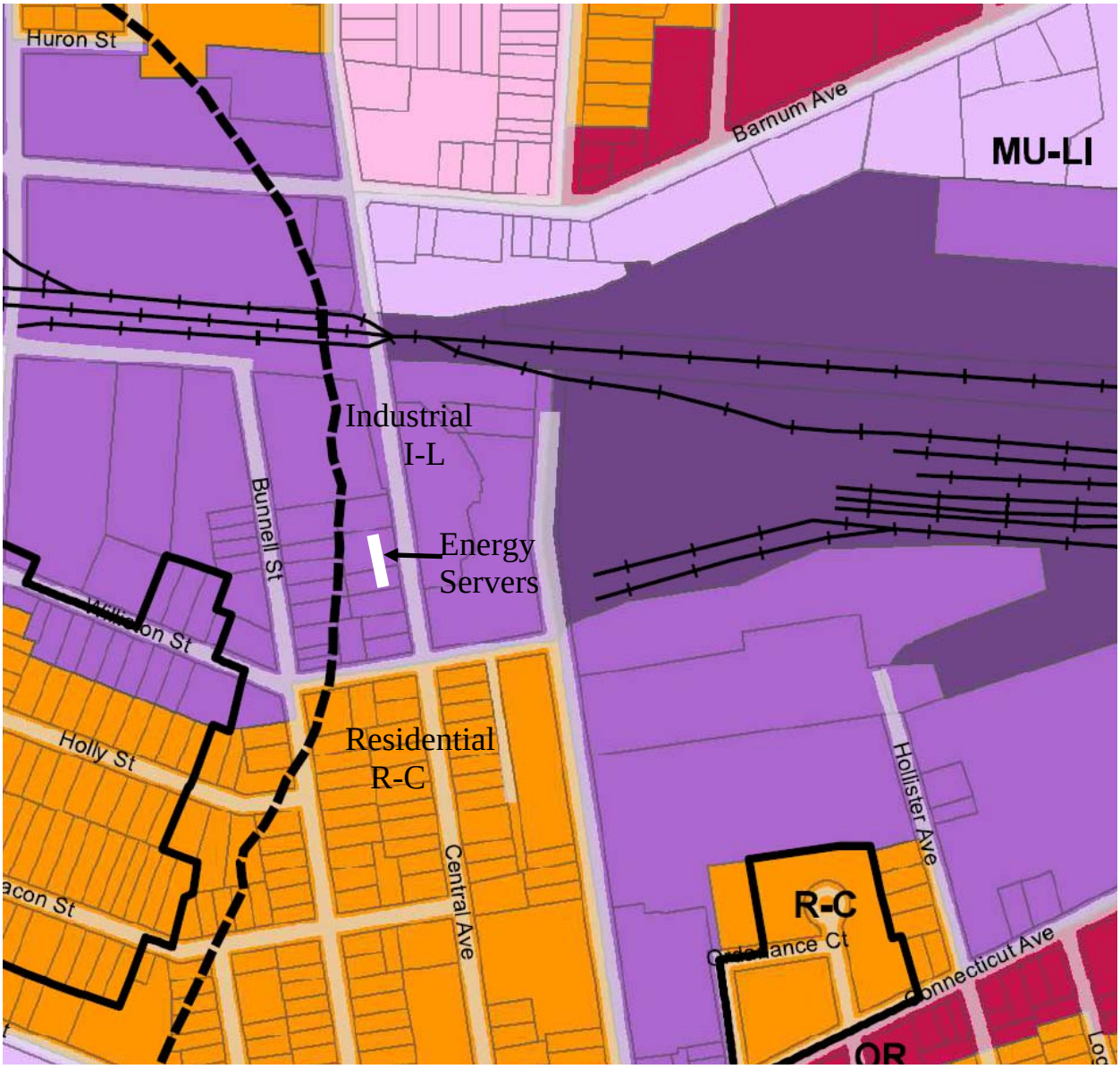
Acoustical Technologies Inc. was tasked as part of a site permitting process with an assessment of potential acoustic issues associated with energy server airborne noise reaching the properties adjacent to the proposed site at 1225 Central Avenue in Bridgeport, CT. Responding to a request from Steve Pearson, a site visit was made on November 14, 2023. During the visit, a survey of the airborne noise levels produced by a Soundboks speaker simulating the airborne noise produced by a 330 KW Bloom Energy Server was made in order to identify potential airborne noise issues. Airborne noise measurements were taken to quantify the propagation of the simulated energy server airborne noise to the adjacent properties. Background airborne noise levels were also made with the speaker off. This document provides an acoustic assessment to assist in meeting acoustic noise concerns during the permitting process for the siting of thirteen Bloom 330 KW, 300 KW and 250 KW energy servers at the 1225 Central Avenue site.

Development of the Acoustic Assessment Plan

The purpose of this effort is to acquire acoustic information useful in explaining the potential airborne noise issues associated with the operation of the Bloom energy servers. The proposed site at 1225 Central Avenue is located in an Industrial Light (I-L) Zone. This zone is surrounded by Industrial Light properties to the north, east and west with an R-C Multi Family Residential Zone to the south. The southerly direction is mostly blocked by buildings in the Industrial Zone and little sound propagation to the Residential Zone to the south is anticipated. Figure 1 shows a section of the Bridgeport zoning map including Central Avenue near Williston and Brunell Streets. It is important to determine whether the airborne noise generated by the UI SCEF Bridgeport Bloom Energy Fuel Cell Project will impact the neighbors near the proposed site.

The acoustic impact is assessed in the following way. The energy servers are yet to be installed so there is no way to measure energy server operating airborne noise levels at the new site. Energy server airborne noise has been measured at another site and both overall and one-thirtieth octave band airborne noise data of a typical Bloom 62.5 KW energy server are available (Reference 3). Using this data, the measured Soundboks speaker noise spectrum data will be adjusted to match that of the new energy servers. (It is assumed that the airborne noise in the existing measured 62.5 KW energy server can be scaled to the thirteen new units.) In order to overcome the potentially high background noise at the Bridgeport site the speaker output will be increased to a noise level more than 30 dB higher than the overall dBA noise level measured on a 62.5 KW energy server at a distance of 5 meters. With the speaker on and the noise level increased to that from the proposed thirteen energy servers, this approach then follows the traditional “What is the airborne noise level at the neighbor’s property line?”. The speaker will be run and airborne measurements made near the proposed energy server locations and at several of the nearest neighbor’s properties. This measured site data can also be used to estimate noise levels at other neighbor’s property lines. The State of Connecticut’s Noise Ordinance[1] and the City of Bridgeport Noise Ordinance[2] will then be consulted to assess the impact of the measured and estimated acoustic levels. Because of the closeness of the proposed energy server site to the nearest properties, noise mitigation may be recommended if the airborne noise estimated for the thirteen energy servers comes near or exceeds the noise requirements at any of the neighbors’ property lines.

Figure 1. Bridgeport Zoning Map Showing the Area near the Thirteen Bloom Energy Servers



Acoustic Measurement Program

The acoustic data necessary to assess the impact of thirteen 330 KW, 300 KW and 250 KW Bloom Energy servers are described below: Airborne sound pressure measurements were conducted at the 1225 Central Avenue site on November 14, 2023 during the morning hours. This testing established both background airborne noise levels and simulated airborne noise levels with the speaker operating. The overall A-weighted airborne noise measurements were made with an ExTech model 407780A Digital Sound Level Meter (s/n 140401544) that had been calibrated prior to and just after the test with a Quest model QC-10 Calibrator (s/n Q19080194). Measurements were taken with A-weighting (frequency filtering that corresponds to human hearing) and with the sound level meter in a Slow response mode. For reference, a noise level

increase of 1 dB is equal to an airborne sound pressure increase of 12.2 per cent. The spectral analysis was made with a Hewlett Packard Dynamic Signal Analyzer (model 3561A s/n 2338A00659). The two PCB microphones (model 130F20 s/n 53994 and s/n 53997) were powered by Wilcoxon Model P702B power supplies. The PCB microphones were also calibrated prior to and after the test with the Quest model QC-10 Calibrator (s/n Q19080194). All measurements were made with the microphones at a height above ground between five and six feet. The Hewlett Packard model HP3561A Dynamic Signal Analyzer was also used to perform overall A-weighted spectral analysis to confirm the ExTech readings. The A-weighted airborne sound pressure data reported herein are all given in dB reference 20 microPascals.

In Bridgeport "speaker on" and background airborne noise measurements were taken at 5 and 10 meters from the proposed energy server site and at the following five nearby properties.

Location	**Business**	**Distance**	**Zone**	**Type**
1 – Energy server North End	Bloom	5 meters	I-L	Industrial
2 – Energy server North End	Bloom	10 meters	I-L	Industrial
3 – Energy server West Direction	Bloom	5 meters	I-L	Industrial
4 – Energy server West Direction	Bloom	10 meters	I-L	Industrial
5 – Energy server South End	Bloom	5 meters	I-L	Industrial
6 – Energy server South End	Bloom	10 meters	I-L	Industrial
P1 – 480 Bunnell Street	Moving Company	11 meters	I-L	Industrial
P2– 465 Bunnell Street	Rotair Aerospace	60 meters	I-L	Industrial
P3 – 1221 Central Ave	New Building	37 meters	I-L	Industrial
P4 – 1240 Central Ave	Restaurant Warehouse	20 meters	I-L	Industrial
P5 – 416 Bunnell Street	Old Building	38 meters	I-L	Industrial

See the Google satellite map in Figure 2 for the approximate measurement locations. Measurements were made with the speaker near the proposed north and south energy server units. Sound pressure data were taken with the ExTech sound level meter. Figures 3 and 4 provide photographs of the speaker locations for the North and South positions, respectively. The speaker at the North position was directed in the north direction for the north measurements and in the west direction for the West measurements. At these locations, a one-minute record of the acoustic noise was analyzed for the speaker in the "on" condition. Also, one minute of background noise data was analyzed at 5 meters for all three speaker positions and at the five nearby property lines.

Airborne noise measurements taken outside are corrupted by rain and wind so a day was selected when the winds were **expected** to be 10 miles per hour or less. Table 1 provides the weather data in Bridgeport on November 14, 2022. Measurements were taken over the period from 10:30 am until 12:30 pm. The temperature and wind speeds are in hourly intervals. The unexpected wind conditions of 9 to 17 mph were not helpful and increased the background noise during the testing. Fortunately, the background noise levels in the 49 to 54 dBA range were low enough to take accurate speaker measurements. Also, there was no rain during the testing. Vehicle traffic along Central Avenue was heavy and many of the measurements had to be delayed until all visible traffic was absent. Measurements were also delayed by a few aircraft and train passings.

Figure 2. Google Map Showing Measurement Positions P1 through P7

Because of the wind and distant traffic noise, background noise levels at all of the property line measurement positions were relatively high with levels from 48 to 54 dBA. (Typical residential areas are usually in the lower 40's dBA.) The highest background airborne noise levels were obtained directly across Brunell Street from the North speaker location. It was possible to clearly hear the airborne noise from the speaker over the background noise at all locations. Airborne noise loss versus range was determined at all these locations. These transfer functions were then applied to the 62.5 KW data from Bristol Hospital[3] in order to estimate the received levels for the new energy servers in Bridgeport. Thirteen energy servers could make up to 11.1 dB more noise than one energy server if they were all in one place. For properties to the east the thirteen energy servers are side by side so the distance to the property line is slightly different for each energy server. (It varies from 18 to 19.7 meters.) The highest level across Central Avenue would be across from the middle of the thirteen units at a value 10.7 dB higher than the level from one energy server. Reasonable estimates for this and the other locations were calculated by looking at the relative distances to the property line for each of the thirteen energy servers. For these other adjacent properties, the measured transfer functions were adjusted to account for the actual distances as found on the Google map. Each energy server is then modeled assuming a very conservative maximum 10-foot source level of 67 dBA.[4]

Figure 3. Bloom North Server Location Looking East at 1225 Central, Speaker Pointing North

Figure 4. Bloom Southern Sever Location Looking North, Speaker Pointing South

The speaker was also turned to the east to allow measurements across Central Avenue to the property at 1240 Central Avenue. The speaker is placed 150 feet from the northern property line at the southern end of the energy servers.

The north direction requires a combination of the noise from all thirteen energy servers. This direction will produce the highest property line noise level to the north since the property line is closest (about 6 meters from the nearest energy server). Each additional energy server is a further 3 meters from the north property line so the thirteen energy servers will be power summed according to their individual distance from the property line. This power sum is about 3.6 dB higher than the noise from a single energy server. The west and south property lines are more than 37 meters away from the nearest energy server and should have noise levels at least 15 dB lower. Calculations were made for all four energy server directions to the nearby property lines.

Table 1. Weather Data near Bridgeport on November 14, 2023
https://www.wunderground.com/history/daily/us/ct/stratford/KBDR/date/2023-11-14

Time (EST)	Temp. (°F)	Humidity (%)	Dew Point (°F)	Barometer (in HG)	Wind Speed	Wind Gust	Wind Direction	Condition
6:52 AM	39 °F	31 °F	73 %	N	5 mph	0 mph	30.16 in	0.0 in
7:52 AM	43 °F	34 °F	71 %	NNW	3 mph	0 mph	30.19 in	0.0 in
8:52 AM	46 °F	35 °F	66 %	NW	9 mph	0 mph	30.21 in	0.0 in
9:52 AM	50 °F	34 °F	54 %	NNW	14 mph	28 mph	30.23 in	0.0 in
10:52 AM	51 °F	34 °F	52 %	NNW	9 mph	23 mph	30.23 in	0.0 in
11:52 AM	51 °F	32 °F	48 %	NNW	16 mph	26 mph	30.23 in	0.0 in
12:52 PM	55 °F	33 °F	43 %	WNW	17 mph	28 mph	30.23 in	0.0 in
1:52 PM	54 °F	31 °F	41 %	NNW	18 mph	28 mph	30.24 in	0.0 in
2:52 PM	54 °F	31 °F	41 %	NNW	12 mph	21 mph	30.25 in	0.0 in

Figure 5. Average One Third Octave Spectrum of the Soundboks Speaker on November 14

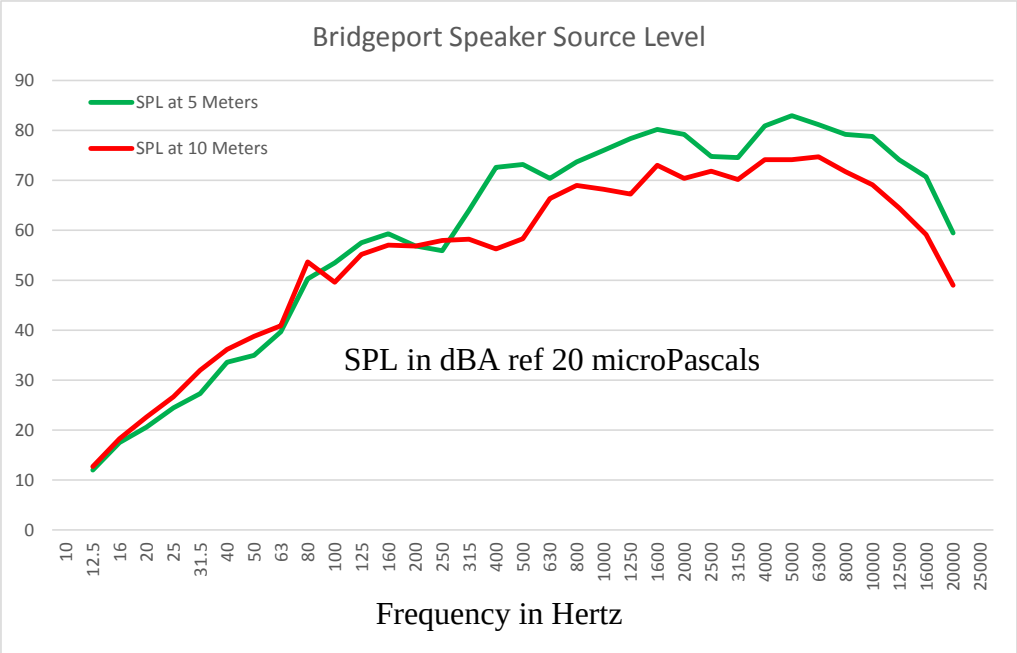


Figure 5 provides the background corrected frequency spectrum for the Soundboks speaker at 5 and 10 meters. Because of the wind condition the levels measured below 80 Hertz may have some wind contribution. At these frequencies the A-weighting applied to the data make this part of the spectrum insignificant. The overall sound levels calculated from this tape-recorded data of the two microphones match the overall levels measured on the Extech sound level meter.

Data Analysis

This section analyzes the airborne noise levels measured at the Bridgeport site and then estimates the received level and transmission loss to nearby properties expected during actual energy server operation. These estimated levels will be compared to the noise limits in the Connecticut and Bridgeport noise ordinances. Speaker operating noise levels at the Bridgeport site are reported in Table 2. Background noise levels at the Bridgeport site are reported in Table 3. The background data are used to correct the speaker levels providing estimates in Table 4 of only the speaker noise contribution at each location. Table 4 also reports the transfer functions and the operating noise levels estimated for the thirteen 330 KW, 300 KW and 250 KW energy servers.

Table 2. Measured Overall Sound Pressure Levels in dBA ref. 20 microPascals with **Speaker On**

Location	Range in Meters	Location	Leq	Max	Min	L10	L90
Speaker On	5	North	89.4	87.9	89.0	89.7	**89.2**
Speaker On	10	North	78.1	80.1	77.6	78.4	**77.8**
Speaker On	5	West	90.6	92.8	89.1	91.3	**90**
Speaker On	10	West	84.4	85.3	83.5	85.0	**84.1**
Speaker On	5	South	90.3	91.1	89.8	90.7	**90.1**
Speaker On	10	South	83.4	84.3	82.7	83.8	**83.1**
480 Bunnell	11	North	87.5	88		87.8	
465 Bunnell	60	West	68.8	72.4	66.7	70.2	**67.6**
1221 Central	37	South	70.7	76.5	67.3	71.8	**69**
1240 Central	20	East	79	82.7	77.1	79.9	**78.3**
416 Bunnell	38	South West	69.7	72.4	66.5	71.0	**68.4**

Leq: Equivalent continuous sound level over the measurement period. – **This is normally the level to be identified as the value to be compared with the steady state overall noise requirement. Because of the wind and traffic noise, the L90 value is used instead.**

SPL MAX: Maximum one-second sound level observed during the measurement period.
SPL MIN: Minimum one-second sound level observed during the measurement period.
L10 - 10% percentile sound level –L10 is the noise level that is exceeded only 10% of the time.

L90: - 90% percentile sound level –L90 is the level that is exceeded 90% of the time.
The CT State Noise Ordinance[1] identifies the L90 acoustic calculation as useful in determining background airborne noise. **This value will be used as the background noise level.**

Table 3 Measured Overall Sound Pressure Levels in dBA ref. 20 microPascals with **Speaker Off**

Location	Range in Meters	Direction	Leq	Max	Min	L10	L90
Speaker Off	5	North	53.3	59.7	47.6	54.8	**48.8**
Speaker Off	10	North	58.2				
Speaker Off	5	West	55.4	63.9	49.1	58.5	**50.2**
Speaker Off	10	West	57.1				
Speaker Off	5	South	53.8				
Speaker Off	10	South	54.0				
480 Bunnell	11	North	53.3	59.7	47.6	54.8	**48.8**
465 Bunnell	60	West	56.6	63.8	53.3	60.1	**54.1**
1221 Central	37	South	54.7	74.9	52.0	56.6	**52.4**
1240 Central	20	East	55.8	77.7	51.6	58.2	**52.6**
416 Bunnell	38	South West	52.3	59.3	49.6	54.7	**50.2**

The overall airborne noise levels are 33 dB to 34 dB higher for the speaker as compared to what was measured from the 17 Bloom 62.5 KW energy servers (56 dBA at 5 meters) at Bristol, CT. Assuming three energy servers were creating the 56 dBA measured, one Bristol energy server would be 4.8 dB lower (51 dBA). The new energy servers are estimated to be about 7 dB higher in level due to their higher power levels (58 dBA). This resulting 31 dB to 32 dB differences in level between the speaker and one new energy server was subtracted from the Bridgeport measured levels to estimate the expected energy server acoustic signature for one new energy server at 5 meters. Column 4 of Table 4 provides the background corrected data for the speaker. The transfer function to each property line is shown in column 5 and the estimated level for thirteen energy servers in shown in column 6. The thirteen energy servers are power summed according to their distance from the property line. (The 58 dBA at 5 meters equates to 62 dBA at 10 feet.) A very conservative five dB of margin is added in the single server estimate to bring the single server source level up to 67 dBA at 10 feet, the source level quoted by Bloom[4].

The Bristol airborne noise levels were used with the Bridgeport transmission loss data to estimate the expected thirteen energy server airborne noise at the eight nearby neighbors. Only the two locations closest to the energy servers on 1225 Central Avenue are near the 70 dBA Industrial noise limit. The North transfer function appears to be about 3 dB stronger than the East transfer function causing the closest North property line to approach the 70 dBA limit (67.4 dBA). The second highest level (61.6 dBA) is expected across the street in the East direction. Locations further than 25 meters from the energy servers will easily meet all the requirements.

Figures 6, 7 and 8 show the Noise Tools[5] calculations for the transfer function from the southerly energy server to the three floors at 110 Williston Street. Figure 6 shows that the top floor receives a direct path with no shielding from the building across Williston Street. The second floor is somewhat shielded with a transfer function only 0.8 dB lower. The first floor is fully shielded with a transfer function 10 dB lower than the third floor. The three floor transfer functions are shown in Table 4 and the noise estimates for the thirteen Bloom servers are expected be at least 12 dB below the lowest residential night time noise requirement (51 dBA).

Table 4 Background Corrected L90 Sound Pressure Levels in dBA ref. 20 microPascals

Location	Range in Meters	Location	L90 Bkgd Corrected	Transfer Function	Property Line	Night Spec	Over Spec
Speaker Off	5	North	**89.2**				
Speaker Off	10	North	**77.8**				
Speaker Off	5	West	**90**				
Speaker Off	10	West	**84.1**				
Speaker Off	5	South	**90.1**				
Speaker Off	10	South	**83.1**	dB re 10’	dBA	dBA	**OK**
480 Bunnell	11	North	**87.2**	1.6	64.3	70	**-5.7**
465 Bunnell	60	West	**67.4**	-15.3	47.4	70	**-22.6**
1221 Central	37	South	**68.9**	-17.6	45.1	70	**-24.9**
1240 Central	20	East	**78.3**	-1.1	61.6	70	**-8.4**
416 Bunnell	38	South West	**68.3**	-18.2	44.5	70	**-25.5**
1190 Central	83	South East		-24.6	38.1	51	**-12.9**
1191 Central	80	South		-24.3	38.4	51	**-12.6**
110 Williston	89	South West	3rd Floor	-32.3	31.2	51	**-18.7**
110 Williston	89	South West	2nd Floor	-33.5	29.8	51	**-21.2**
110 Williston	89	South West	1stFloor	-42.3	23.4	51	**-27.6**

Figure 6. Noise Tool Model of Third Floor Sound Transfer to 110 Williston Street

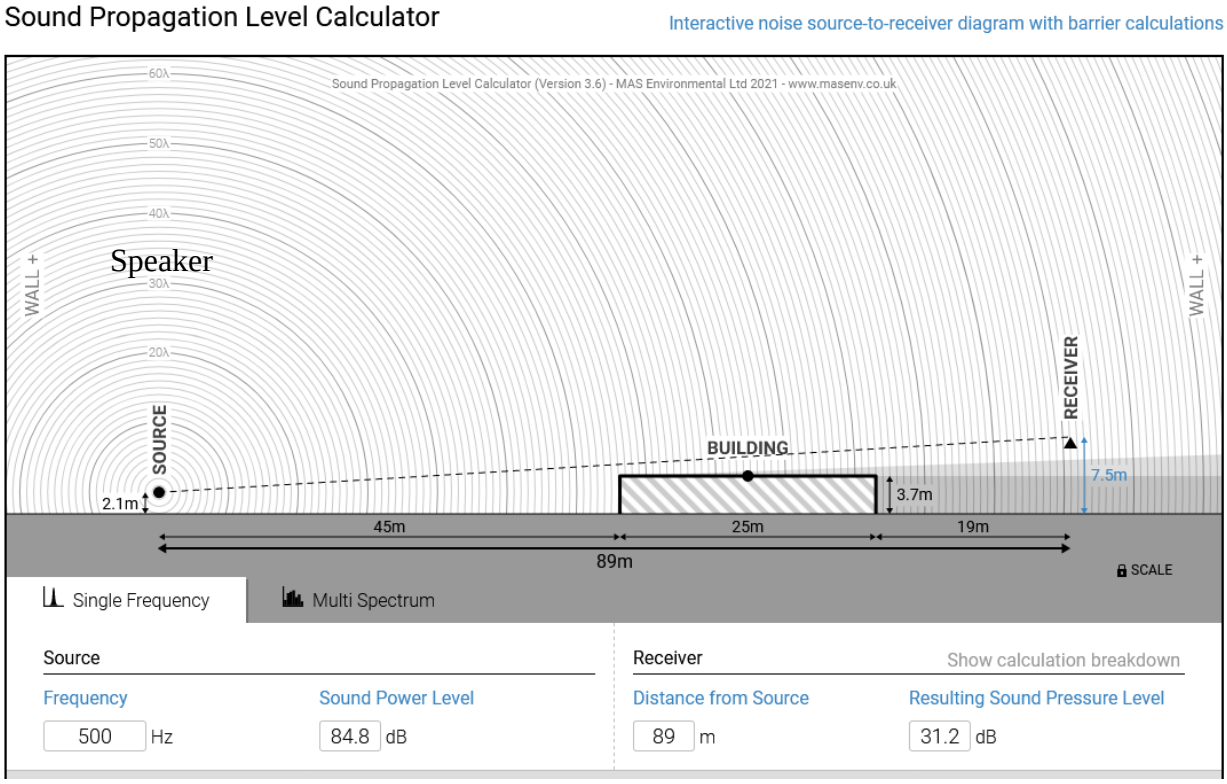


Figure 7. Noise Tool Model of Second Floor Sound Transfer to 110 Williston Street

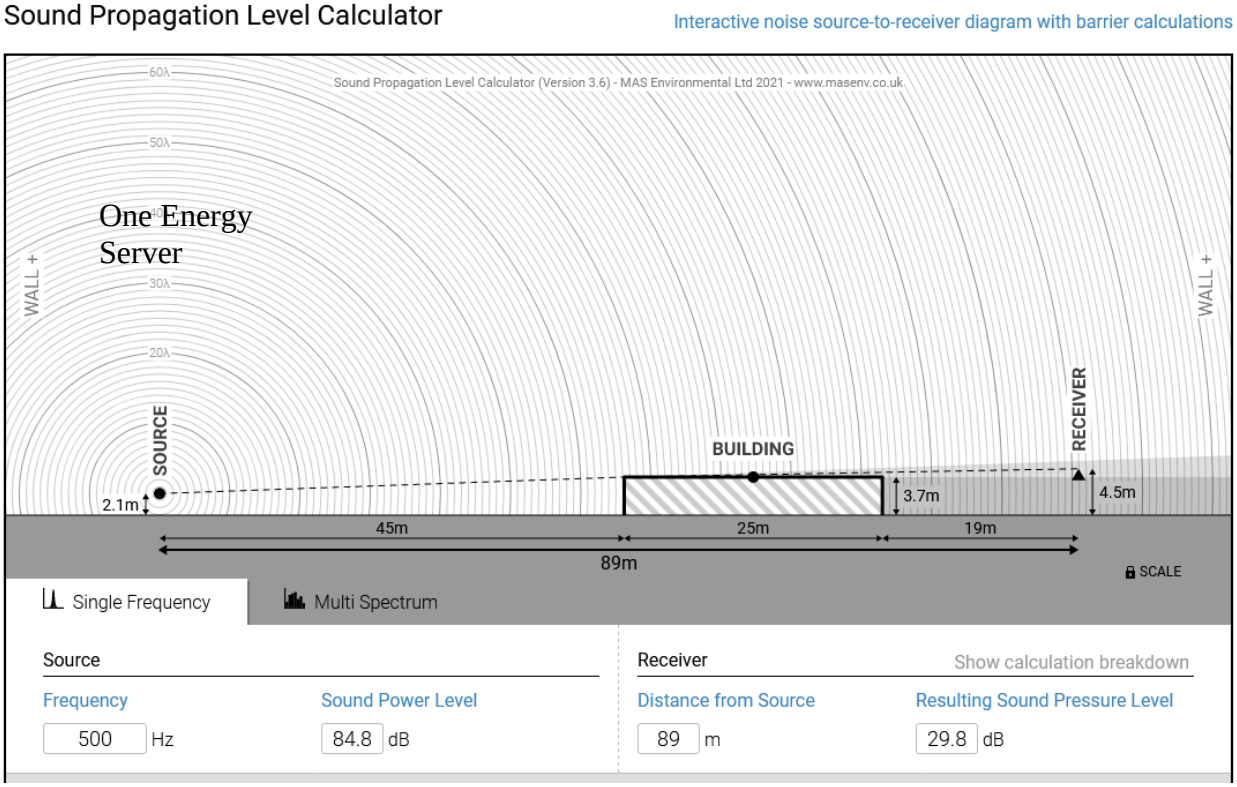
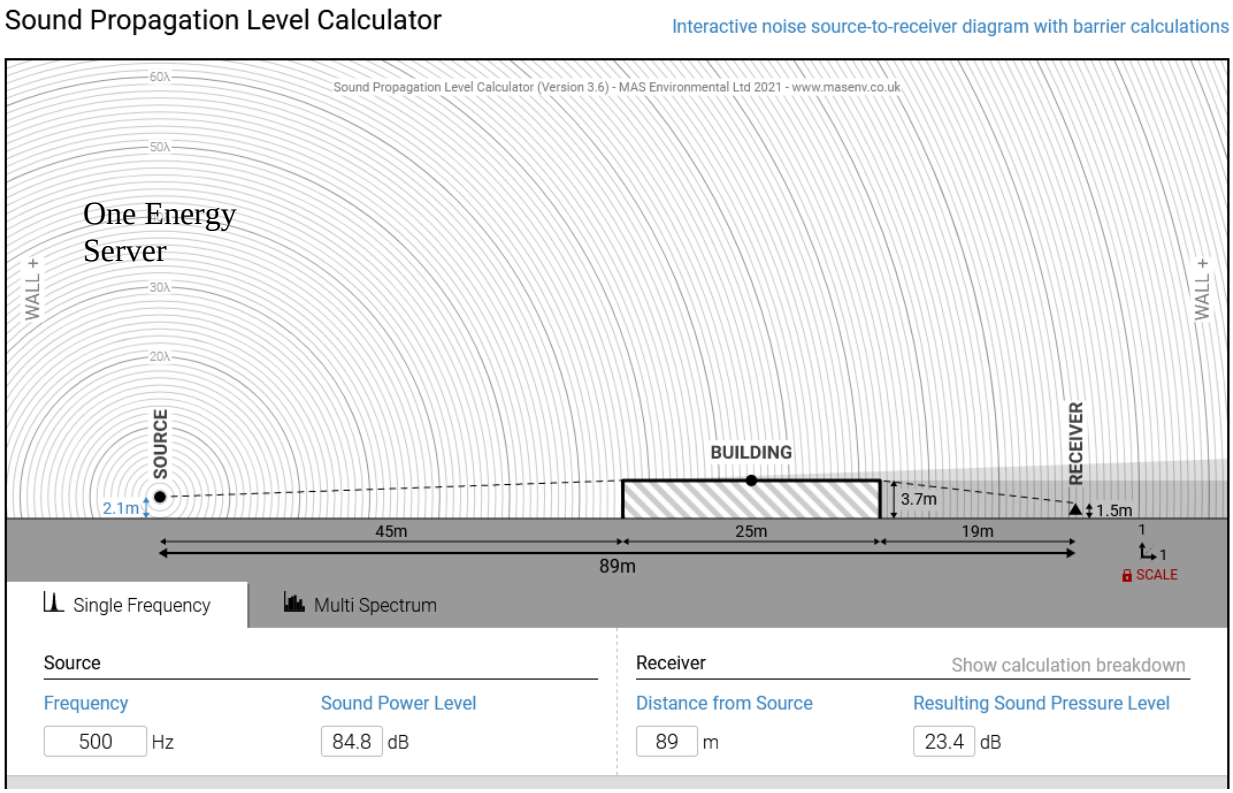


Figure 8. Noise Tool Model of First Floor Sound Transfer to 110 Williston Street



The airborne noise levels to be produced by the Bloom energy servers are shown in Table 4. For each of the eight locations the Bridgeport measurements are corrected to account for the higher speaker levels. The noise correction for the energy server is estimated to be 28 dB for the North location because the speaker levels are that much higher than the Bristol Energy server levels. The speaker at the South location was estimated to be 29 dB higher than the Bristol Energy server levels.

The measurements at Bridgeport were taken at various distances from the speaker and then corrected to estimate the expected noise from thirteen energy servers. The airborne noise levels in the Industrial Zone are all below 70 dBA by at least 5 dB. The airborne noise levels in the Residential Zone are all below 51 dBA by at least 12 dB.

Allowable Noise Levels

Connecticut's regulation for the control of noise provides in *CT section 22a-69*-3[1] the requirements for noise emission in Connecticut. *Section 22a-69*-3.1 states that no person shall cause or allow the emission of excessive noise beyond the boundaries of his/her Noise Zone so as to violate any provisions of these Regulations. The CT ordinance will be used to evaluate the noise generated by the thirteen Bloom energy servers. (The Bridgeport noise ordinance has the same noise limits.) Following sections discuss each type of noise using the results obtained from the November 14, 2023 speaker measurements in Bridgeport and the Bloom 62.5 KW energy server test in Bristol, CT on November 20, 2023.

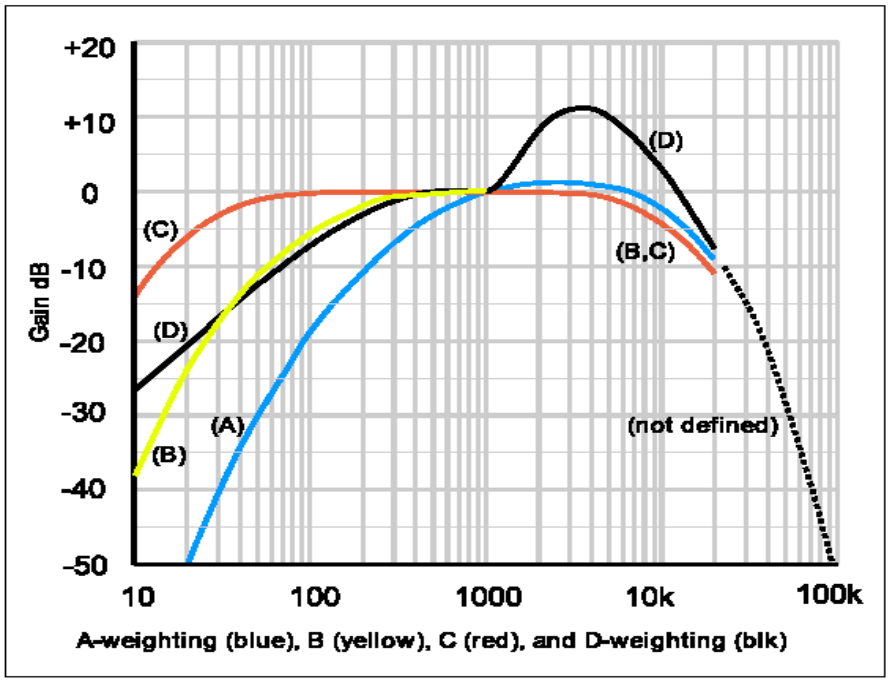
As stated above, the Bridgeport site is located in an Industrial Zone on 1225 Central Avenue and is adjacent to a Residential Zone to the south. The closest residential zone is only 80 meters away. Based on the analysis resulting in Table 4 the airborne noise from the thirteen new energy servers should be well below the 51 dBA noise limit in the residential zone. All other nearby residential properties at greater distances are expected to be well below the day time and night time Residential Zone noise limits for an emitter in an Industrial zone. The closest northern and eastern properties are expected to be at least 5 dB below the industrial noise limit of 70 dBA. Other industrial zone properties are expected to be well below the industrial noise limit. These estimates assume the Bloom source level of 67 dBA at 10 feet. The Bristol measurements of 62.5 KW energy servers indicate the 330 KW source level may be as much as 5 dB lower.

Impulse Noise

The Connecticut noise code states in *CT section 22a-69*-3.2 (part a) *Impulse Noise* that no person shall cause or allow the emission of impulse noise in excess of 80 dB peak sound pressure level during the night time to any class A Noise Zone. Night time is defined as 10 pm to 7 am. *CT section 22a-69-3.2 (part b) Impulse Noise* states that no person shall cause or allow the emission of impulse noise in excess of 100 dB peak sound pressure level at any time to any Noise Zone. The Bridgeport noise ordinance sets the same limits for Impulse Noise.

Figure 9. Acoustic Airborne Noise Weighting Curves

http://upload.wikimedia.org/wikipedia/commons/3/39/Acoustic_weighting_curves_(1).svg



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Impulse noise in excess of 80 dBA was not observed during any of the property line measurements of the Bloom 62.5 KW energy servers made at the Bristol site on 20 Nov., 2023[3].

The maximum level measured was 64 dBA ten meters from the north side of the servers using the ExTech sound level meter. The closest Bridgeport property showed -1.6 dB of transmission loss so the highest expected level would be below 70 dB in the industrial zone. Impulse levels in the residential zone should be 25 dB lower. Given the steady state nature of the energy server's noise signature there should be no acoustic issues with the State of Connecticut's or the City of Bridgeport's impulse noise requirements.

A few words are in order to discuss the difference between A-weighted and un-weighted impulse noise. A-weighting emphasizes the middle and higher frequencies while reducing the influence of the low frequencies. Figure 9 above plots the A-weighting curve versus frequency in blue. Below a frequency of 1 kiloHertz the acoustic level is attenuated by increasing amounts. The reduction is about 10 dB at 200 Hertz, 20 dB at 90 Hertz and 30 dB at 50 Hertz. It also reduces the level at very high frequency being down in level by 10 dB at 20 kiloHertz. Typical energy server measurements show the unweighted overall levels to be about 9 dB higher than the A-weighted noise levels. Adding 9 dB to the Bristol measured levels brings the peak impulse up to about 77 dB reference 20 microPascals in the industrial zone (52 dBA in the residential zone.). The impulse noise levels near 1225 Central Avenue on the, north, east and west should be no higher than 77 dB reference 20 microPascals, well below the 100 dB limit.

Prominent Discrete Tones

The Connecticut regulation for the control of noise states in *CT section 22a-69-3.3 Prominent discrete tones:* Continuous noise measured beyond the boundary of the Noise Zone of the noise emitter in any other Noise Zone which possesses one or more audible discrete tones shall be considered excessive noise when a level of 5 dBA below the levels specified in section 3 of these Regulations is exceeded. The CT Regulations establish different noise limits for different land use zones. Residential (homes and condominiums) and hotel uses are in Class A. Schools, business, parks, recreational activities and government services are in Class B. Forestry and related services are in Class C. By my reading of the regulations the Bridgeport site is a Class C emitter in an Industrial Zone. The noise zone standards in *CT section 22a-69-3.5* state that a Class C emitter cannot exceed the following overall sound pressure levels:

To Class C 70 dBA To Class B 66 dBA To Class A 61 dBA (day) 51 dBA (night)

The discrete tones limits are 5 dBA lower so that no tone may be higher than the following:

To Class C 65 dBA To Class B 61 dBA To Class A 56 dBA (day) 46 dBA (night)

The Bridgeport noise ordinance does not discuss discrete tones so the CT Noise Ordinance will be used. To address the discrete tone issue, we use measured spectral data from the Reference 3 Bristol testing. The data is the maximum level received in 1/30 octave bands for frequencies from 0.32 to 100,000 Hz. Figure 10 plots the airborne noise measured 5 meters from the north side of the Bloom energy servers in 1-30th octave bands. This figure shows some discrete tones in the middle frequencies produced by the Bloom energy servers. The eight largest tones are given in Table 5. The highest is 64.1 dB reference 20 microPascals at 7.5 Hz. The second highest tone is at 58.75 Hz at a level of 58.5 dB reference 20 microPascals. All the remaining

tones are below 58 dBA. The A-weighted discrete tone corrections are given in the 4th row of Table 5. Incorporating the transmission loss to the properties gives the A-weighted levels in the last three rows of Table 5 after the 9.5 dB correction for thirteen units is added. (The 9.5 dB correction for 13 units over estimates by about 1.5 dB the combination of thirteen energy servers spaced 10 meters apart.) All the frequencies at the nearest industrial properties near 1225 Central Avenue have levels that are below the 65 dBA Industrial Zone requirement by at least 20 dB. The nearby residential properties should meet the discrete tone requirements by 29 dB. There should be no acoustic issue with the CT discrete tone noise requirements at any of the properties.

Figure 10. Bristol Tones for Energy Servers in 1-30th octave bands

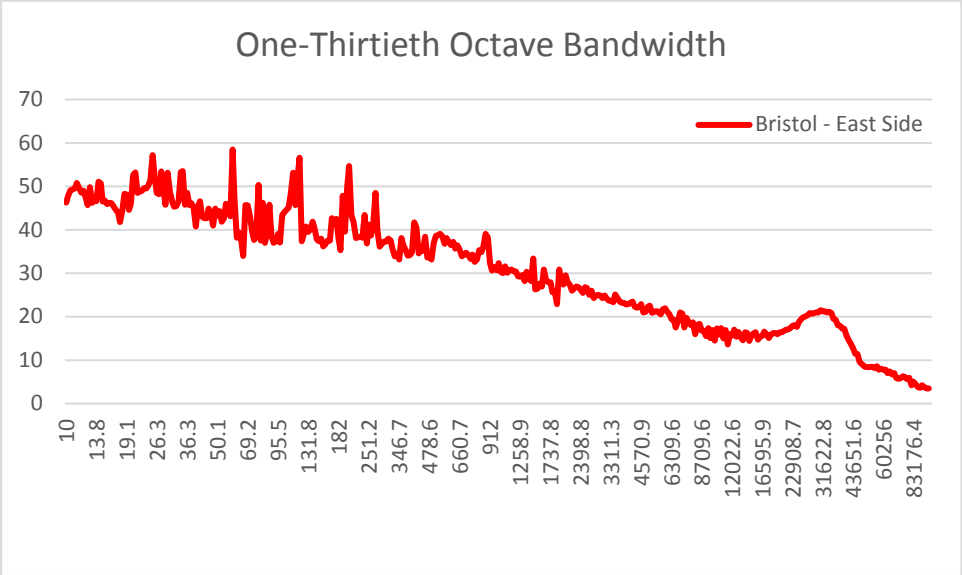


Table 5. Peak Discrete Sound Pressure Level Estimates in dB ref. 20 microPascals

Location	Range Meters	7.25	20.75	25	27.25	29.75	34.5	58.75	78.25
Allowed Level		**65/46**	**65/46**	**65/46**	**65/46**	**65/46**	**65/46**	**65/46**	**65/46**
Bristol	5	64.1	53.2	57.2	53.4	53.1	53.5	58.5	50.3
A Weighting		-80.8	-49.4	-44.8	-42.3	-40.8	-37.6	-27.4	-22.7
Bridgeport 1 Server	5	-16.7	12.4	31.1	27.6	3.8	11.1	12.3	15.9
13 Energy servers	5	-7.2	21.9	40.6	37.1	13.3	20.6	21.8	25.4
P1– 480 Bunn	11	-5.6	23.5	**42.2**	38.7	14.9	22.2	23.4	27
P4– 1240 Cent	20	-8.3	20.8	**39.5**	36	12.2	19.5	20.7	24.3
P6– 1190 Cent	83	-31.8	-3	**16**	12.5	-11.3	-4	-2.8	0.8
P7– 1191 Cent	80	-31.5	-2.4	**16.3**	12.8	-11	-3.7	-2.5	1.1

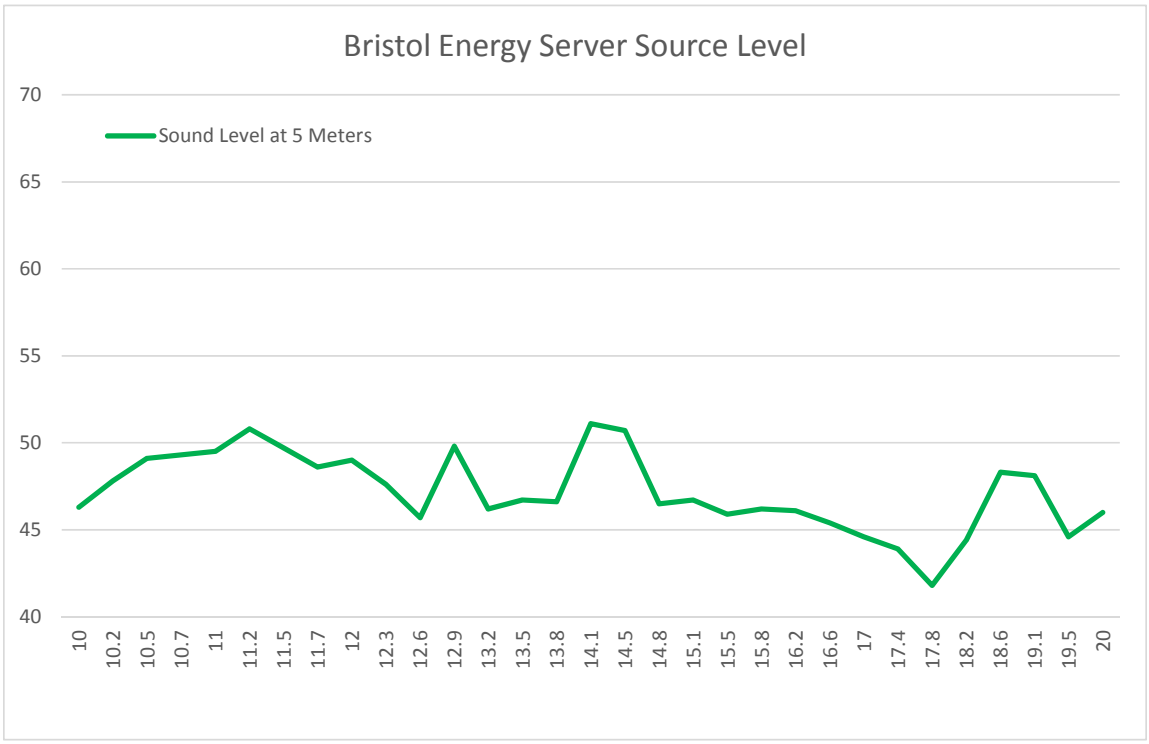
Acoustical Technologies Inc.

Infrasonic and Ultrasonic Noise

The Connecticut regulation for the control of noise states in *CT section 22a-69-3.4 Infrasonic and Ultrasonic* that no person shall emit beyond his/her property infrasonic or ultrasonic sound in excess of 100 dB at any time. 100 dB with respect to the reference of 20 microPascals is a sound pressure of 2 Pascals or 0.00029 psi. Infrasonic sounds are sound pressure fluctuations below a frequency of 20 Hertz. Ultrasonic sounds are sound pressure fluctuations at frequencies above 20,000 Hertz. There is no mention in the Bridgeport Noise Ordinance that limits infrasonic or ultrasonic noise so the State of CT Noise Ordinance will be used.

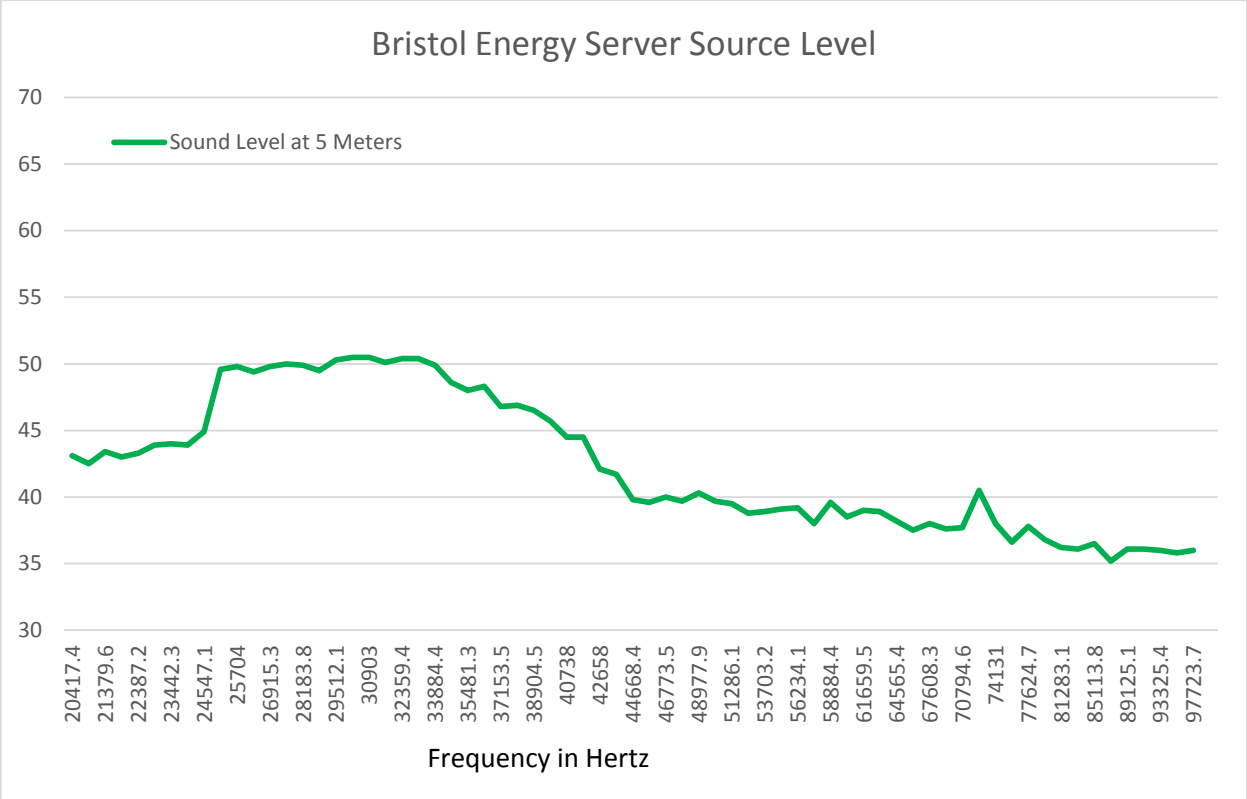
Narrow bandwidth sound pressure spectrums in dB reference 20 microPascals made at the northern Bristol 5-meter Energy server location can be used to compare with the infrasonic and ultrasonic noise requirements. The Bristol airborne noise data were processed in the 0 to 100 Hertz and 0 to 100,000 Hertz frequency ranges. The bandwidth of each data point is 0.375 Hertz for the 100 Hertz range and 375 Hertz for the 100,000 Hertz frequency range. The infrasonic noise for frequencies up to 20 Hertz is shown in Figure 11 for the 62.5 KW units at Bristol[3]. The maximum level at 5 meters is 51 dB reference 20 microPascals. The entire 20 Hertz band can be power summed and never exceeds 63 dB reference 20 microPascals at 5 meters in Bristol. After adding 1.6 dB for the maximum transfer function correction at Point P1, the closest site, and adding the gain of 9.5 dB for thirteen units, the 73.7 dB level is well below the Infrasonic requirement of 100 dB for the Bridgeport site. The noise levels at all the other nearby neighbors will be lower than 71 dB. There should be no issue with the infrasonic noise requirement at any of the neighboring residential properties.

Figure 11. Infrasonic Noise from Bristol Energy Servers in 1-30th octave bands



The ultrasonic noise for frequencies up to 100 kiloHertz is given in Figure 12. The Bristol data uses a microphone with flat high frequency performance and provides a good estimate for the 62.5 KW energy servers. The maximum level at 5 meters is 50.5 dB reference 20 microPascals. The entire 80 KiloHertz band from 20 to 100 kiloHertz has been power summed and never exceeds a noise level of 64 dB reference 20 microPascals 5 meters from the energy server at Bristol. After adding 1.6 dB for the maximum transfer function correction at Point P1, the closest site, and adding the gain of 9.5 dB for thirteen units, the 74.8 dB level is well below the Infrasonic requirement of 100 dB for the Bridgeport site. The noise levels at all the other nearby residential neighbors will be lower than 72 dB and there should be no issue with ultrasonic noise at any of the neighboring properties.

Figure 12. Ultrasonic Noise from Bristol Energy server Energy servers in 1-30th octave bands



Overall Sound Pressure Levels

The Connecticut regulations for the control of noise state that
(a) No person in a Class C Noise Zone shall emit noise exceeding the levels below:

To Class C 70 dBA To Class B 66 dBA To Class A 61 dBA (day) 51 dBA (night)

The Bridgeport site is in an Industrial Zone that has a Residential Zone to the south. The nearby neighbors in the Residential Zone have airborne noise limits of 61 dBA during the day and 51 dBA at night. The Industrial Zone limit is 70 dBA.

The estimated overall A-weighted sound pressure levels for thirteen energy servers in dBA reference 20 microPascals are given in column 6 of Table 4 above using the background corrected measurements made on November 14, 2022. The second column gives the approximate distance from the energy servers to the measurement location, with locations identified by a P number in Figure 2. Column 3 gives the location/direction from the energy server to the property. The airborne noise values given in column 4 are the estimated received level for the Soundboks speaker. The transfer functions in column 7 provide the loss in sound level from the energy servers to the property lines. The values in column 6 provide the estimated airborne noise levels at the property lines with thirteen energy servers operating. The nearby values are all below the Industrial Zone noise limit of 70 dBA and also below the Residential Zone noise limits. The increasing loss with distance to all other residential properties means all the properties should be lower than 51 dBA. Operation of the UI SCEF Bridgeport Bloom Energy Fuel Cell Project will have no significant acoustic impact at all the nearby properties adjacent to the Bloom energy server site on Central Avenue.

Conclusions

The purpose of this effort is to evaluate the acoustical environment at the Bridgeport sire during operation of the thirteen Bloom 330 KW, 300 KW and 250 KW energy servers. This effort has been accomplished and the results show that the operation of the UI SCEF Bridgeport Bloom Energy Fuel Cell Project will meet all of the State of Connecticut and City of Bridgeport airborne noise requirements at all the nearby properties. Other residences in all directions are expected to meet all the noise requirements because they are far enough away from the new energy servers and have airborne noise levels well below 51 dBA. Locations at distances greater than 100 meters should not hear the operating energy servers.

References

1) CT DE&EP *Noise Control Regulation RCSA Section 22a-69*-1 to 22a-69-7.4 http://www.ct.gov/dep/lib/dep/regulations/22a/22a-69-1through7.pdf

2) Bridgeport Noise Ordinance, http://portal.ct.gov/BridgeportNoiseOrdinancepdf.pdf

3) Bristol Hospital Airborne Noise Report, Acoustical technologies Inc., 26 November 2023

4) Bloom website https://www.bloomenergy.com/wp-content/uploads/bloom-energy-server-2022.pdf

5) https://noisetools.net/barriercalculator was used in the sound pressure calculations