WESTERN CONNECTICUT STATE UNIVERSITY

CONNECTICUT STATE COLLEGE & UNIVERSITIES

WESTERN CONNECTICUT STATE UNIVERSITY MASTER PLAN UPDATE

TECHNICAL APPENDIX

DECEMBER, 2016

PERKINS+WILL

CONNECTICUT STATE COLLEGE & UNIVERSITIES

WESTERN CONNECTICUT STATE UNIVERSITY MASTER PLAN UPDATE

TECHNICAL APPENDIX

DECEMBER, 2016

TECHNICAL APPENDIX

CONTENTS

HARD COPY FILES

DIGITAL FILES

1. ENROLLMENT PROJECTIONS

SOURCE: WESTERN CONNECTICUT STATE UNIVERSITY

The enrollment table on the opposite page was provided by WCSU and approved by the Connecticut State Colleges & Universities. It reflects undergraduate enrollment by headcount. The table on the following page illustrates existing and projected graduate student enrollment by headcount.

WCSU Enrollment Projections by Major			Fall	Fall	Fall	Fall	Fall	Fall	Fall	Fall	Fall	Fall	Fall	Fall	Fall	Fall	Fall	Fall	Fall	Fall
School		Degree	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
	UNDERGRADUATE LEVEL	Obj.	FTE	FTE	FTE	FTE	FTE	FTE	FTE	FTE	FTE	FTE	FTE	FTE	FTE	FTE	FTE	FTE	FTE	FTE
MSAS	Undeclared (incl. Pre-Health, Pre-Law)	BA	511	554	500	540	590	629	472	472	472	477	481	486	486	486	486	486	486	486
MSAS	Contract Major/Honors Interdisciplinary	BA/BS	1	6	4	0	1	0	2	2	2	2	2	2	2	2	2	2	2	2
MSAS	Liberal Arts	AS	24	45	52	37	24	24	20	20	20	20	20	21	21	21	22	22	22	22
MSAS	Liberal Arts (NEW)	BA	0	0	0	0	0	0	0	20	20	20	20	21	21	21	22	22	22	22
MSAS	Biology	BA	170	183	182	192	192	201	195	195	195	197	199	201	201	201	201	201	201	201
MSAS	Medical Technology (discontinued)	BS	28	18	10	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0
MSAS	Chemistry	BA	54	63	49	56	53	58	62	62	62	63	63	64	64	64	64	64	64	64
MSAS	Communication	BA	217	192	196	193	190	180	178	180	181	183	185	187	187	187	190	190	190	190
MSAS	Media Arts	BA	46	72	76	78	67	78	75	76	77	77	78	79	79	80	80	80	80	80
MSAS	Computer Science	BA	56	60	68	80	82	100	108	109	110	111	112	113	113	113	113	113	113	113
MSAS	Digital and Interactive Media Arts (NEW)	BA	0	0	0	0	0	0	0	25	30	36	40	40	50	50	50	50	50	50
MSAS	English: American/ Comparative Lit.	BA	40	53	46	49	41	39	41	41	41	42	42	42	42	42	42	42	42	42
MSAS	American Studies (English/History)	BA	26	26	29	12	10	7	5	5	5	5	5	5	0	0	0	0	0	0
MSAS	History	BA	128	141	116	119	85	67	67	67	67	67	68	69	69	69	70	70	70	70
MSAS	Mathematics	BA	41	46	36	44	39	32	38	38	38	39	39	40	40	40	40	40	40	40
MSAS	Earth and Planetary Sciences	BA	10	8	9	7	7	11	6	6	6	6	6	6	6	6	6	6	6	6
MSAS	Meteorology	BS	46	41	47	52	37	36	45	45	45	45	46	46	46	46	46	46	46	46
MSAS	Psychology	BA	277	314	302	317	330	318	307	307	307	310	313	316	318	318	320	320	325	325
MSAS	Social Sciences	BA	23	25	37	36	24	25	26	26	26	26	26	27	27	27	28	28	29	29
MSAS	Anthropology/Sociology	BA	33	47	53	43	41	41	32	32	32	32	32	32	32	32	32	32	32	32
MSAS	Economics	BA	17	20	22	24	23	24	21	21	21	21	21	22	22	22	22	22	22	22
MSAS	Political Science	BA	53	41	46	66	63	46	45	46	46	46	47	47	48	48	48	48	48	48
MSAS	Spanish	BA	15	10	7	7	7	10	8	8	8	9	9	9	9	9	9	9	9	9
MSAS	Professional Writing	BA	110	127	137	120	107	104	88	89	90	91	92	93	93	93	94	94	94	94
Ancell	Justice & Law Administration	BS	426	457	474	451	446	459	429	429	429	429	429	429	429	429	429	429	429	429
Ancell	Accounting	BBA	236	144	211	192	198	207	215	215	215	215	215	215	215	215	215	215	215	215
Ancell	Business Administration, Undeclared	BBA	99	105	98	102	99	93	106	106	106	106	106	106	106	106	106	106	106	106
Ancell	Finance	BBA	131	100	108	89	88	92	98	98	98	98	98	98	98	98	98	98	98	98
Ancell	Management	BBA	280	256	262	245	221	200	226	226	226	226	226	226	226	226	226	226	226	226
Ancell	Management Information Systems	BBA	53	51	50	62	66	56	54	54	54	54	54	54	54	54	54	54	54	54
Ancell	Marketing	BBA	189	160	140	124	115	137	143	143	143	143	143	143	143	143	143	143	143	143
SPS	Pre-Elementary Education	BS	0	0	0	51	36	36	36	36	36	36	36	36	36	36	36	36	36	36
SPS	Elementary Ed (Academic Major)	BS	330	306	258	134	110	85	61	54	47	28	20	11	0	0	0	0	0	0
SPS	Elementary Ed (IDM)	BS	0	0	0	0	0	0	12	40	48	54	54	54	54	54	54	54	54	54
SPS	Pre-Secondary Education	BS	0	0	0	14	20	27	38	38	38	38	39	39	39	39	39	39	39	39
SPS	Secondary Ed	BS	234	225	199	109	70	56	34	34	34	34	35	35	36	36	36	36	36	3
SPS	Health Education (PreK-12)	BS	33	36	29	17	11	10	8	8	8	8	8	8	8	8	8	8	8	8
SPS	Health Promotion Studies****	BS	106	121	138	164	191	200	239	239	239	239	239	239	239	239	239	239	239	239
SPS	Nursing (Bacalaurerate)***	BS	143	122	140	137	142	143	156	168	190	208	208	208	208	208	208	208	208	208
SPS	Pre-Nursing	BS	102	122	143	129	135	100	98	100	100	100	100	100	100	100	100	100	100	100
SPS	Registered Nursing (RN to BSN)	BS	20	35	43	44	44	47	47	47	47	47	47	47	47	47	47	47	47	47
SPS	Social Work	BA	134	142	142	131	132	138	159	159	159	159	159	159	159	159	159	159	159	159
VPA	Art	BA	165	153	144	119	106	110	107	110	115	117	119	120	120	120	120	120	120	120
VPA	Music	BA	36	42	28	27	25	27	22	25	30	30	30	30	30	30	30	30	30	30
VPA	Music Education	BS	117	120	114	100	95	94	81	90	90	90	90	90	90	90	90	90	90	90
VPA	Music, Audio & Production	BM	0	0	0	12	33	45	51	53	55	57	57	57	57	57	57	57	57	57
VPA	Music, Jazz Studies	BM	34	32	31	26	34	33	35	35	35	35	35	35	35	35	35	35	35	35
VPA	Music, Performance	BM	41	36	37	31	34	29	33	33	33	33	33	33	33	33	33	33	33	33
VPA	Theatre Arts	BA	78	82	66	65	73	60	72	73	74	76	78	78	78	78	78	78	78	78
VPA	Musical Theatre	BA		9	26	34	41	46	48	50	60	65	65	65	65	65	65	65	65	65
	Non-Matriculant	ND	137	119	128	130	122	97	96	94	94	94	94	94	94	94	94	94	94	94
	Total: Undergraduate Level		5047	5065	5031	4814	4698	4659	4543	4647	4703	4744	4763	4776	4774	4776	4786	4786	4792	4759

WCSU Enrollment Projections by Major

WCSU Enrollment Projections by Major			Fall	Fall	Fall	Fall	Fall	Fall	Fall	Fall	Fall	Fall	Fall	Fall	Fall	Fall	Fall	Fall	Fall	Fall
School	GRADUATE LEVEL	Degree	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
MSAS	Bio. & Env. Sciences (suspended & revised)	MA	9	4	2	1	0	0	0	0	7	7	7	7	7	7	7	7	7	7
MSAS	Earth and Planetary Sciences	MA	3	6	7	2	2	4	2	2	2	2	2	2	2	2	2	2	2	2
MSAS	English	MA	14	10	10	10	6	8	5	5	5	5	5	5	5	5	5	5	5	5
MSAS	History	MA	19	12	9	7	9	9	9	9	9	9	9	9	9	9	9	9	9	9
MSAS	Mathematics	MA	7	3	3	5	3	3	1	1	1	2	2	2	2	2	2	2	2	2
MSAS	Creative & Professional Writing	MFA	34	39	34	29	26	23	27	27	27	28	28	28	28	28	28	28	28	28
Ancell	Business Administration	MBA	22	21	24	25	15	16	20	35	35	35	60	60	60	60	90	90	90	90
Ancell	Health Care Administration	MHA	9	11	11	14	10	7	4	20	20	30	30	40	40	40	40	40	40	40
Ancell	Justice Administration (suspended)	MS	4	4	4	4	4	4	5	3	3	0	0	0	0	0	0	0	0	0
SPS	Counselor Education	MS	56	43	40	43	41	40	43	43	43	43	43	43	43	43	43	43	43	43
SPS	Instructional Leadership	Ed.D.	31	18	25	13	22	15	24	24	24	24	24	24	24	24	24	24	24	24
SPS	Education	MS	62	52	33	32	22	18	19	20	22	25	25	25	25	25	25	25	25	25
SPS	Applied Behavior Analysis	MS	0	0	0	0	0	0	11	15	20	25	35	45	45	45	45	45	45	45
SPS	Applied Behavior Analysis (grad. cert.)	PMC	0	0	0	0	5	5	3	3	2	0	0	0	0	0	0	0	0	0
SPS	Secondary Education (suspended)*	MAT	19	7	12	9	9	5	0	0	14	14	14	14	14	14	14	14	14	14
SPS	Nursing	MSN	11	11	18	17	15	25	25	25	25	25	25	25	25	25	25	25	25	25
SPS	Nursing Education	Ed.D.	0	0	0	5	4	6	5	6	6	6	6	6	6	6	6	6	6	6
SPS	School Counseling**	CERT	1	1	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0
SPS	Elementary Education**	CERT	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPS	Secondary Education**	CERT	7	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SVPA	Art	MFA	31	23	19	13	18	17	22	22	23	25	25	25	25	25	25	25	25	25
SVPA	Music Education**	CERT	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SVPA	Music Education	MS	6	7	5	3	6	5	4	5	4	4	4	4	4	4	4	4	4	4
SVPA	Jazz Pedagogy (Proposed)	MM	0	0	0	0	0	0	0	8	10	12	12	12	12	12	12	12	12	12
	Non-Matriculant	ND	26	22	29	41	29	27	32	32	32	32	32	32	32	32	32	32	32	32
	Total: Graduate Level		**378**	**300**	**285**	**275**	**246**	**237**	**259**	**305**	**334**	**352**	**386**	**407**	**407**	**407**	**437**	**437**	**437**	**430**
	WCSU Grand Total		**5425**	**5365**	**5316**	**5089**	**4944**	**4896**	**4802**	**4952**	**5037**	**5096**	**5150**	**5183**	**5182**	**5183**	**5223**	**5223**	**5229**	**5189**

SPS	Secondary Education (suspended)	*See list
SPS	School Counseling**	** Discontinued
SPS	Elementary Education**	** Discontinued
SPS	Secondary Education**	** Discontinued
SVPA	Music Education**	** Discontinued
SPS	Nursing (Bacalaurerate)	***Assuming increase of additional spaces as recommended by working group.
SPS	Health Promotion Studies	****Staffing and Accreditation standards or constraints that are only partially known at this time, but are expected to constrain growth of this program.

									Benchmark											
	Total: Undergraduate Level								**4543**	**4647**	**4703**	**4744**	**4763**	**4776**	**4774**	**4776**	**4786**	**4786**	**4792**	**4759**
	Growth/Reduction %									**2%**	**4%**	**4%**	**5%**	**5%**	**5%**	**5%**	**5%**	**5%**	**5%**	**5%**
	Total: Graduate Level								**259**	**305**	**334**	**352**	**386**	**407**	**407**	**407**	**437**	**437**	**437**	**430**
	Growth/Reduction %									**18%**	**29%**	**36%**	**49%**	**57%**	**57%**	**57%**	**69%**	**69%**	**69%**	**66%**
	WCSU Grand Total								**4802**	**4952**	**5037**	**5096**	**5150**	**5183**	**5182**	**5183**	**5223**	**5223**	**5229**	**5189**
										150	**235**	**294**	**348**	**381**	**380**	**381**	**421**	**421**	**427**	**387**
	Growth/Reduction %									**3%**	**5%**	**6%**	**7%**	**8%**	**8%**	**8%**	**9%**	**9%**	**9%**	**8%**

2. MASTER PLAN 10-YEAR DETAILED SPACE PROGRAM

Campus Master Plan — DRAFT 23-Apr-16
Western Connecticut State University — **Revised 24-Oct-16**
Connecticut State Colleges & Universities

Summary

Departmental Profile	Existing Fall 2015	Current Need Fall 2015	Projected Fall 2019	Projected Fall 2026
Midtown Campus Baseline				
Academic Space	157,185 sf	178,103 sf	194,806 sf	197,278 sf
Support Space	249,367 sf	288,897 sf	310,318 sf	315,545 sf
Contingency		*11,675 sf*	*12,628 sf*	*12,821 sf*
Total Assignable Square Feet	406,552 sf	478,675 sf	517,752 sf	525,643 sf
Vacant Space	39,772 sf			
Total Net Need				79,319 sf
Gross Square Feet Expansion				136,758 sf
Westside Campus Baseline				
Academic Space	85,222 sf	109,753 sf	109,331 sf	112,207 sf
Support Space	162,115 sf	248,305 sf	259,578 sf	261,793 sf
Contingency		*8,951 sf*	*9,223 sf*	*9,350 sf*
Total Assignable Square Feet	247,337 sf	367,009 sf	378,132 sf	383,351 sf
Vacant Space	0 sf			
Total Net Need				136,014 sf
Gross Square Feet Expansion				212,522 sf
University Total				349,279 sf

Midtown Campus Baseline

Departmental Profile	Existing Fall 2015	Current Need Fall 2015	Projected Fall 2020	Projected Fall 2026
Classroom Space	45,419 sf	35,161 sf	39,991 sf	41,107 sf
Ancell School of Business	0 sf	0 sf	0 sf	0 sf
School of Arts & Sciences	83,423 sf	98,031 sf	103,221 sf	104,277 sf
School of Professional Studies	26,159 sf	41,233 sf	47,916 sf	48,216 sf
School of Visual & Performing Arts	2,183 sf	3,678 sf	3,678 sf	3,678 sf
Academic Total	**157,185 sf**	**178,103 sf**	**194,806 sf**	**197,278 sf**
ASF per Student FTE	*41 sf*	*47 sf*	*46 sf*	*45 sf*
Centers & Institutes	865 sf	4,765 sf	5,861 sf	5,861 sf
Honors College (Irfan Kathwari Honors House)	568 sf	2,568 sf	2,568 sf	2,568 sf
Grant Funded Programs	0 sf	0 sf	3,124 sf	3,124 sf
Academic Support	3,325 sf	7,458 sf	7,458 sf	7,458 sf
Library	60,246 sf	63,267 sf	70,728 sf	72,995 sf
Technology	7,854 sf	9,660 sf	9,660 sf	9,660 sf
Assembly & Exhibition	14,643 sf	19,865 sf	19,865 sf	19,865 sf
Athletics & Recreation	25,111 sf	19,765 sf	19,765 sf	19,765 sf
Student Activities	21,567 sf	35,232 sf	39,387 sf	40,650 sf
Child Care	1,836 sf	2,456 sf	2,456 sf	2,456 sf
Student Services	39,899 sf	45,086 sf	45,086 sf	45,086 sf
Administrative Services	27,036 sf	31,420 sf	31,420 sf	31,420 sf
Campus Services	46,417 sf	47,355 sf	52,940 sf	54,637 sf
Support Total	**249,367 sf**	**288,897 sf**	**310,318 sf**	**315,545 sf**
ASF per Student FTE	*66 sf*	*76 sf*	*73 sf*	*72 sf*
Contingency		*11,675 sf*	*12,628 sf*	*12,821 sf*
Grand Total	**406,552 sf**	**478,675 sf**	**517,752 sf**	**525,643 sf**
ASF per Student FTE	*107 sf*	*126 sf*	*122 sf*	*120 sf*
Unassigned Space	39,772 sf	0 sf	0 sf	0 sf
Total Student FTEs				
Undergraduate	3,456.33	3,456.33	3,729.70	3,861.46
Graduate	332.10	332.10	505.50	509.50
Total	3,788.43	3,788.43	4,235.20	4,370.96
Percentage of Growth from Fall 2015		*0%*	*12%*	*15%*
Assignable Square Feet Needed		*32,351 sf*	*71,428 sf*	*79,319 sf*
Gross Square Feet Needed		*55,778 sf*	*123,152 sf*	*136,758 sf*

Campus Master Plan — DRAFT — 23-Apr-16
Western Connecticut State University — Revised — **24-Oct-16**
Connecticut State Colleges & Universities

Westside Campus Baseline

Departmental Profile	Existing Fall 2015	Current Need Fall 2015	Projected Fall 2019	Projected Fall 2026
Classroom Space	13,442 sf	10,549 sf	10,967 sf	11,238 sf
Ancell School of Business	12,323 sf	20,065 sf	22,527 sf	22,683 sf
School of Arts & Sciences	3,340 sf	5,678 sf	5,678 sf	5,678 sf
School of Professional Studies	6,313 sf	7,654 sf	0 sf	0 sf
School of Visual & Performing Arts	49,804 sf	65,807 sf	70,158 sf	72,608 sf
Academic Total	**85,222 sf**	**109,753 sf**	**109,331 sf**	**112,207 sf**
ASF per Student FTE	*59 sf*	*76 sf*	*70 sf*	*69 sf*
Centers & Institutes	192 sf	250 sf	1,500 sf	3,000 sf
Hosted Entities	424 sf	600 sf	600 sf	600 sf
Grant Funded Programs	0 sf	0 sf	0 sf	0 sf
Academic Support	111 sf	720 sf	720 sf	720 sf
Library	4,149 sf	7,949 sf	8,600 sf	8,958 sf
Technology	9,588 sf	12,098 sf	12,098 sf	12,098 sf
Assembly & Exhibition	37,711 sf	44,515 sf	44,515 sf	44,515 sf
Athletics & Recreation	77,431 sf	142,431 sf	142,431 sf	142,431 sf
Student Activities	23,909 sf	25,678 sf	34,400 sf	34,400 sf
Child Care	0 sf	0 sf	0 sf	0 sf
Student Services	1,337 sf	3,457 sf	3,457 sf	3,457 sf
Administrative Services	1,709 sf	2,657 sf	2,657 sf	2,657 sf
Campus Services	5,554 sf	7,949 sf	8,600 sf	8,958 sf
Support Total	**162,115 sf**	**248,305 sf**	**259,578 sf**	**261,793 sf**
ASF per Student FTE	*112 sf*	*172 sf*	*166 sf*	*161 sf*
Contingency		*8,951 sf*	*9,223 sf*	*9,350 sf*
Grand Total	**247,337 sf**	**367,009 sf**	**378,132 sf**	**383,351 sf**
ASF per Student FTE	*171 sf*	*254 sf*	*242 sf*	*235 sf*
Unassigned Space	479 sf	0 sf	0 sf	0 sf
Total Student FTEs				
Undergraduate	1,389.18	1,389.18	1,449.00	1,502.00
Graduate	56.15	56.15	114.65	126.65
Total	1,445.33	1,445.33	1,563.65	1,628.65
Percentage of Growth from Fall 2015		*0%*	*8%*	*13%*
Assignable Square Feet Needed		*119,193 sf*	*130,316 sf*	*135,535 sf*

Classroom Space

Departmental Profile	Existing Fall 2015	Current Need Fall 2015	Projected Need Fall 2020	Projected Need Fall 2026
Ancell School of Business		7,678 sf	7,691 sf	7,705 sf
Macricostas School of Arts & Sciences		30,335 sf	32,443 sf	33,444 sf
School of Professional Studies		4,826 sf	7,548 sf	7,663 sf
School of Visual & Performing Arts		2,872 sf	3,276 sf	3,533 sf
Classroom Space Total	**45,419 sf**	**45,710 sf**	**50,958 sf**	**52,345 sf**
ASF per Student FTE	*9 sf*	*9 sf*	*9 sf*	*9 sf*

Total Student FTEs

Undergraduate	4,845.51	4,845.51	5,178.70	5,363.46
Graduate	388.25	388.25	620.15	636.15
Total	5,233.76	5,233.76	5,798.85	5,999.61
Percentage of Growth from Fall 2014		*0%*	*11%*	*15%*

Campus Master Plan — DRAFT — 12-Apr-16
Western Connecticut State University — **REVISED** — **24-Oct-16**
Connecticut State Colleges & Universities

Ancell School of Business

Departmental Profile	Existing Fall 2015	Current Need Fall 2015	Projected Need Fall 2020	Projected Need Fall 2026
Accounting	731 sf	2,184 sf	2,184 sf	2,184 sf
Finance	430 sf	3,729 sf	3,729 sf	3,729 sf
JLA (Justice & Law Administration)	2,302 sf	5,848 sf	6,298 sf	6,298 sf
Management	1,978 sf	2,948 sf	4,110 sf	4,266 sf
MIS (Management Information Systems)	5,678 sf	3,019 sf	3,019 sf	3,019 sf
Marketing	1,204 sf	2,338 sf	3,188 sf	3,188 sf
Ancell School of Business Total	**12,323 sf**	**20,065 sf**	**22,527 sf**	**22,683 sf**
ASF per Student FTE		*25 sf*	*26 sf*	*26 sf*
Total Classroom Need (Straight Calculation)	NA	7,678 sf	7,691 sf	7,705 sf
Total Classroom Need (Night Usage)	NA	7,436 sf	7,487 sf	7,558 sf

Current & Projected Student FTEs (By Content)

Undergraduate	773.06	773.06	778.00	778.00
Graduate	30.65	30.65	73.65	85.65
Total	**803.71**	**803.71**	**851.65**	**863.65**
Percentage of Growth		0%	6%	7%

Current & Projected Faculty (Fulltime)

Accounting	6	6	6	6
Finance	4	4	4	4
JLA (Justice & Law Administration)	10	10	10	10
Management	7	7	9	10
MIS (Management Information Systems)	6	6	6	6
Marketing	5	5	5	5
Ancell School of Business Total	38	38	40	41
Percentage of Growth		*0%*	*5%*	*8%*

Ancell School of Business
Conceptual Singular Building Program

School Profile	Existing Fall 2015	Projected Fall 2014	Projected Need Fall 2020	Projected Need Fall 2026
Accounting	731 sf	2,184 sf	2,184 sf	2,184 sf
Finance	430 sf	3,729 sf	3,729 sf	3,729 sf
JLA (Justice & Law Administration)	2,302 sf	5,848 sf	6,298 sf	6,298 sf
Management	1,978 sf	2,948 sf	4,110 sf	4,266 sf
MIS (Management Information Systems)	5,678 sf	3,019 sf	3,019 sf	3,019 sf
Marketing	1,204 sf	2,338 sf	3,188 sf	3,188 sf
Departmental Subtotal	**12,323 sf**	**20,065 sf**	**22,527 sf**	**22,683 sf**
Classroom Space		7,678 sf	7,691 sf	7,705 sf
Computer Lab Space		6,816 sf	6,862 sf	6,910 sf
Total Shared Academic Space		**14,493 sf**	**14,553 sf**	**14,615 sf**
Total Academic Space		**34,558 sf**	**37,081 sf**	**37,298 sf**
Large Assembly Space(s)		3,750 sf	3,750 sf	3,750 sf
Interview Space		900 sf	900 sf	900 sf
Project Space		1,200 sf	1,200 sf	1,200 sf
Concession/Small Business		450 sf	450 sf	450 sf
Dean's Office		1,600 sf	1,600 sf	1,600 sf
Student Lounge Space		2,000 sf	2,000 sf	2,000 sf
Campus Services		600 sf	600 sf	600 sf
Administrative & Support Space		**10,500 sf**	**10,500 sf**	**10,500 sf**
Total Assignable Square Feet		45,058 sf	47,581 sf	47,798 sf
Total Gross Square Feet		83,442 sf	88,112 sf	88,515 sf

Campus Master Plan
Western Connecticut State University
Connecticut State Colleges & Universities

DRAFT 12-Apr-16
REVISED **24-Oct-16**

Macricostas School of Arts & Sciences

Departmental Profile	Existing Fall 2015	Current Need Fall 2015	Projected Need Fall 2020	Projected Need Fall 2026
Biology and Environmental Science	25,072 sf	21,503 sf	23,478 sf	23,478 sf
Chemistry	16,051 sf	15,686 sf	15,686 sf	15,686 sf
Communication	2,863 sf	9,168 sf	9,468 sf	9,618 sf
Computer Science	3,030 sf	5,363 sf	6,548 sf	6,698 sf
English	3,321 sf	2,650 sf	2,650 sf	2,650 sf
History and Non-Western Cultures	4,402 sf	2,800 sf	2,800 sf	2,800 sf
Mathematics	9,834 sf	7,610 sf	7,910 sf	7,910 sf
Philosophy	492 sf	1,488 sf	1,938 sf	1,938 sf
Physics, Astronomy, and Meteorology	10,050 sf	8,301 sf	8,421 sf	8,421 sf
Psychology	3,672 sf	8,998 sf	8,953 sf	8,953 sf
Social Sciences	2,445 sf	7,724 sf	7,824 sf	8,424 sf
World Languages and Literature	846 sf	2,420 sf	2,420 sf	2,576 sf
Writing, Linguistics & Creative Process, Linguistics & Creative Process	1,345 sf	4,323 sf	5,128 sf	5,128 sf
Macricostas School of Arts & Sciences Total	**83,423 sf**	**98,031 sf**	**103,221 sf**	**104,277 sf**
ASF per Student FTE	*28 sf*	*33 sf*	*33 sf*	*32 sf*
Total Classroom Need	*NA*	*30,335 sf*	*32,443 sf*	*33,444 sf*

Total Current & Projected Student FTEs for the Macricostas School of Arts & Sciences

Undergraduate	2,893.45	2,893.45	3,056.29	3,173.36
Graduate	69.10	69.10	76.50	76.50
Total	2,962.55	2,962.55	3,132.79	3,249.86
Percentage of Growth		*0%*	*6%*	*10%*

Macricostas School of Arts & Sciences

Departmental Profile	Existing Fall 2015	Current Need Fall 2015	Projected Need Fall 2020	Projected Need Fall 2026
Current & Projected Faculty (Fulltime)				
Biology and Environmental Science	10	10	12	12
Chemistry	10	10	8	8
Communication	9	9	11	12
Computer Science	4	4	5	6
English	9	9	9	9
History and Non-Western Cultures	10	10	10	10
Mathematics	12	12	14	14
Philosophy	2	2	5	5
Physics, Astronomy, and Meteorology	4	4	4	4
Psychology	11	11	11	11
Social Sciences	12	12	13	14
World Languages and Literature	2	2	2	3
Division Total	95	95	104	108
Percentage of Growth		0%	9%	14%

Campus Master Plan — DRAFT — 12-Apr-16
Western Connecticut State University — **REVISED** — **24-Oct-16**
Connecticut State Colleges & Universities

School of Professional Studies

Departmental Profile	Existing Fall 2015	Current Need Fall 2015	Projected Need Fall 2020	Projected Need Fall 2026
Education & Educational Psychology Department	6,165 sf	11,022 sf	11,472 sf	11,622 sf
Health Promotion & Exercise Sciences	4,253 sf	7,780 sf	7,950 sf	7,950 sf
Nursing Department	9,257 sf	14,245 sf	14,245 sf	14,245 sf
Public Health	0 sf	0 sf	2,538 sf	2,688 sf
Social Work Department	1,484 sf	3,186 sf	3,472 sf	3,472 sf
Simulation Center	0 sf	0 sf	3,240 sf	3,240 sf
Western at Waterbury	5,000 sf	5,000 sf	5,000 sf	5,000 sf
School of Professional Studies Total	26,159 sf	41,233 sf	47,916 sf	48,216 sf
ASF per Student FTE	32 sf	50 sf	43 sf	43 sf
Total Classroom Need (Straight Calculation)	NA	4,826 sf	7,548 sf	7,663 sf
Total Classroom Need (Evening Calculation)	NA	2,683 sf	4,652 sf	4,692 sf
Total Student FTEs				
Undergraduate	562.88	562.88	673.42	688.09
Graduate	263.00	263.00	429.00	433.00
Total	825.88	825.88	1,102.42	1,121.09
Percentage of Growth			33%	36%
Current & Projected Faculty (Fulltime)				
Education & Educational Psychology Department		14	14	14
Health Promotion & Exercise Sciences		6	9	9
Nursing Department		21	21	21
Social Work Department		6	6	6
Western at Waterbury		0	0	0
School of Professional Studies Total		47	50	50
Percentage of Growth			6%	6%

School of Visual & Performing Arts

Departmental Profile	Existing Fall 2015	Current Need Fall 2015	Projected Need Fall 2020	Projected Need Fall 2026
Art	21,252 sf	26,568 sf	28,428 sf	30,578 sf
Music	19,157 sf	25,197 sf	27,528 sf	27,828 sf
Theatre Arts	9,395 sf	14,043 sf	14,203 sf	14,203 sf
School of Visual & Performing Arts Total	49,804 sf	65,807 sf	70,158 sf	72,608 sf
ASF per Student FTE	78 sf	103 sf	99 sf	95 sf
Total Classroom Need	NA	2,872 sf	3,276 sf	3,533 sf

Total Current & Projected Student FTEs for the School of Visual & Performing Arts

Undergraduate	616.12	616.12	671.00	724.00
Graduate	25.50	25.50	41.00	41.00
Total	641.62	641.62	712.00	765.00
Percentage of Growth		0%	11%	19%

Current & Projected Faculty (Fulltime)

Art	7	11	13	14
Music	14	18	20	20
Theatre Arts	3	5	5	5
Division Total	24	34	37	39
Percentage of Growth		40%	55%	61%

Midtown Scenarios

Category, School & Department		Existing Assignable Square Feet	Programmatic Need	Scenario 1: New Academic Building Around Health & Recreation	Scenario 2: New Campus Center; Old Campus Center Converted to Academic	Scenario 3: Conversion of Berkshire to Campus Center & Recreation
Berkshire Hall						
Academic Space						
Classroom Space						
	General Use (Class, Seminar)	6,126 sf	0 sf	12,000 sf	9,000 sf	0 sf
School of Arts & Science						
	Communication	728 sf	9,805 sf	9,805 sf	0 sf	0 sf
	Computer Science	0 sf	6,698 sf	6,698 sf	0 sf	0 sf
	English	528 sf	0 sf	0 sf	0 sf	0 sf
	Foreign Language & Literature	752 sf	0 sf	0 sf	0 sf	0 sf
	Psychology	0 sf	8,953 sf	8,953 sf	0 sf	0 sf
	Social Sciences	0 sf	8,424 sf	8,424 sf	0 sf	0 sf
	Writing, Linguistics & Creative Process	1,757 sf	5,128 sf	5,128 sf	0 sf	0 sf
School of Professional Studies						
School of Professional Studies						
	Nursing	0 sf	14,425 sf	0 sf	14,425 sf	0 sf
	Simulator	0 sf	3,400 sf	0 sf	3,400 sf	0 sf
	Health Promo & Exer. Science	4,557 sf	7,500 sf	0 sf	7,500 sf	0 sf
	Total Academic Space	**14,448 sf**	**NA**	**51,008 sf**	**34,325 sf**	**0 sf**
Support Space						
Assembly & Exhibition Space						
	Auditorium/Theater	0 sf	3,600 sf	0 sf	0 sf	3,600 sf
Athletics, Recreation & Phy Ed						
	Athletics, Recreation & Phy Ed	18,484 sf	16,000 sf	0 sf	16,000 sf	3,600 sf
Grant Funded Programs						
	CONNCAP	1,216 sf	1,750 sf	0 sf	0 sf	0 sf
	Gen. Use	273 sf	0 sf	0 sf	0 sf	0 sf
Student Activities						
	Bookstore	0 sf	0 sf	0 sf	0 sf	2,100 sf
	Campus Ministries	0 sf	0 sf	0 sf	0 sf	150 sf
	Campus Radio	0 sf	0 sf	0 sf	0 sf	950 sf
	Campus Store	0 sf	0 sf	0 sf	0 sf	2,600 sf
	Food Services	0 sf	0 sf	0 sf	0 sf	18,000 sf
	Lounge Space	481 sf	900 sf	900 sf	900 sf	9,000 sf
	Student Center & Activities	0 sf	0 sf	0 sf	0 sf	16,500 sf
Student Services						
	Career Center	0 sf	3,600 sf	0 sf	0 sf	3,600 sf
	Innovation Center	0 sf	0 sf	0 sf	0 sf	6,000 sf
	Center for Student Involvement	0 sf	2,350 sf	0 sf	0 sf	0 sf
	Counseling	0 sf	0 sf	0 sf	0 sf	0 sf
Vacant						
	Vacant	8,385 sf	0 sf	0 sf	0 sf	0 sf
	Total Support Space	**28,839 sf**	**NA**	**900 sf**	**16,900 sf**	**66,100 sf**
	Building Total Assignable Square Feet	**43,287 sf**	**NA**	**51,908 sf**	**51,225 sf**	**66,100 sf**
	Gross Square Feet *(Addition Only)*			15,965 sf	14,700 sf	42,246 sf

Midtown Scenarios

Category, School & Department		Existing Assignable Square Feet	Programmatic Need	Scenario 1: New Academic Building Around Health & Recreation	Scenario 2: New Campus Center; Old Campus Center Converted to Academic	Scenario 3: Conversion of Berkshire to Campus Center & Recreation
Student Center (Existing)						
Academic Space						
Classroom Space						
	General Use (Class, Seminar)	0 sf	0 sf	0 sf	12,000 sf	12,000 sf
School of Arts & Science						
	Communication	0 sf	9,805 sf	0 sf	9,805 sf	0 sf
	Computer Science	0 sf	6,698 sf	0 sf	6,698 sf	0 sf
	Psychology	0 sf	8,953 sf	0 sf	9,000 sf	0 sf
	Social Sciences	0 sf	8,424 sf	0 sf	0 sf	0 sf
	Writing, Linguistics & Creative Process	0 sf	5,128 sf	0 sf	5,128 sf	0 sf
School of Professional Studies						
	Nursing	0 sf	14,425 sf	0 sf	0 sf	14,425 sf
	Public Health	0 sf	2,700 sf	0 sf	0 sf	2,700 sf
	Simulator	0 sf	3,400 sf	0 sf	0 sf	3,400 sf
	Health Promo & Exer. Science	0 sf	7,500 sf	0 sf	0 sf	7,500 sf
	Total Academic Space	**0 sf**	**NA**	**0 sf**	**42,631 sf**	**40,025 sf**
Support Space						
Assembly & Exhibition Space						
	Auditorium/Theater	2,479 sf	3,600 sf	3,600 sf	0 sf	0 sf
Athletics, Recreation & Phy Ed						
	Athletics, Recreation & Phy Ed	0 sf	16,000 sf	0 sf	0 sf	12,400 sf
Campus Services						
	Facilities	2,262 sf	1,500 sf	1,500 sf	750 sf	750 sf
	Mail Room	1,521 sf	1,800 sf	1,800 sf	0 sf	0 sf
Student Activities						
	Bookstore	1,928 sf	2,100 sf	2,100 sf	0 sf	0 sf
	Campus Ministries	102 sf	150 sf	150 sf	0 sf	0 sf
	Campus Radio	1,158 sf	950 sf	950 sf	0 sf	0 sf
	Campus Store	3,521 sf	2,600 sf	2,600 sf	0 sf	0 sf
	Food Services	12,416 sf	18,000 sf	18,000 sf	0 sf	0 sf
	Lounge Space	5,553 sf	9,000 sf	9,000 sf	3,000 sf	2,000 sf
	Student Center & Activities	12,379 sf	16,500 sf	16,500 sf	0 sf	0 sf
Student Services						
	Career Center	1,166 sf	3,600 sf	3,600 sf	0 sf	0 sf
	Center for Student Involvement	1,638 sf	2,350 sf	2,350 sf	0 sf	0 sf
	Counseling	1,348 sf	1,500 sf	1,500 sf	0 sf	0 sf
Technology						
	Academic Computing	536 sf	900 sf	900 sf	1,800 sf	1,800 sf
Vacant		178 sf	0 sf	0 sf	0 sf	0 sf
	Total Support Space	**48,185 sf**	**NA**	**64,550 sf**	**5,550 sf**	**16,950 sf**
	Building Total Assignable Square Feet	**48,185 sf**	**NA**	**64,550 sf**	**48,181 sf**	**56,975 sf**
	Gross Square Feet *(Addition Only)*			30,306 sf	0 sf	16,278 sf

Midtown Scenarios

Category, School & Department		Existing Assignable Square Feet	Programmatic Need	Scenario 1: New Academic Building Around Health & Recreation	Scenario 2: New Campus Center; Old Campus Center Converted to Academic	Scenario 3: Conversion of Berkshire to Campus Center & Recreation
New Academic Building						
Academic Space						
Classroom Space						
	General Use (Class, Seminar)	0 sf	0 sf	9,000 sf	0 sf	12,000 sf
School of Arts & Science						
	Communication	0 sf	9,805 sf	0 sf	0 sf	9,800 sf
	Computer Science	0 sf	6,698 sf	0 sf	0 sf	6,700 sf
	Psychology	0 sf	8,953 sf	0 sf	0 sf	9,000 sf
	Social Sciences	0 sf	8,424 sf	0 sf	0 sf	0 sf
	Writing, Linguistics & Creative Process	0 sf	5,128 sf	0 sf	0 sf	5,200 sf
School of Professional Studies						
	Nursing	0 sf	14,425 sf	14,425 sf	0 sf	0 sf
	Simulator	0 sf	3,400 sf	3,400 sf	0 sf	0 sf
	Health Promo & Exer. Science	0 sf	7,500 sf	7,500 sf	0 sf	0 sf
	Total Academic Space	**0 sf**	**NA**	**34,325 sf**	**0 sf**	**42,700 sf**
Support Space						
Athletics, Recreation & Phy Ed						
	Athletics, Recreation & Phy Ed	0 sf	16,000 sf	16,000 sf	0 sf	0 sf
Campus Services						
	Facilities	0 sf	0 sf	750 sf	0 sf	750 sf
	Mail Room	0 sf	0 sf	0 sf	0 sf	0 sf
Student Activities						
	Food Services	0 sf	0 sf	0 sf	0 sf	0 sf
	Lounge Space	0 sf	0 sf	3,000 sf	0 sf	3,000 sf
Student Services						
	Career Center	0 sf	0 sf	0 sf	0 sf	0 sf
	Center for Student Involvement	0 sf	0 sf	0 sf	0 sf	0 sf
	Counseling	0 sf	2,400 sf	0 sf	0 sf	0 sf
Technology						
	Academic Computing	0 sf	0 sf	900 sf	0 sf	2,700 sf
	Total Support Space	**0 sf**	**NA**	**20,650 sf**	**0 sf**	**6,450 sf**
	Building Total Assignable Square Feet	**0 sf**	**NA**	**54,975 sf**	**0 sf**	**49,150 sf**
	Gross Square Feet			101,806 sf	0 sf	91,019 sf

Midtown Scenarios

Category, School & Department		Existing Assignable Square Feet	Programmatic Need	Scenario 1: New Academic Building Around Health & Recreation	Scenario 2: New Campus Center; Old Campus Center Converted to Academic	Scenario 3: Conversion of Berkshire to Campus Center & Recreation
New Student Center						
Academic Space						
Classroom Space						
	General Use (Class, Seminar)	0 sf	0 sf	0 sf	0 sf	0 sf
	Total Academic Space	**0 sf**	**NA**	**0 sf**	**0 sf**	**0 sf**
Support Space						
Assembly & Exhibition Space						
	Auditorium/Theater	0 sf	3,600 sf	0 sf	3,600 sf	0 sf
Athletics, Recreation & Phy Ed						
	Athletics, Recreation & Phy Ed	0 sf	16,000 sf	0 sf	0 sf	0 sf
Campus Services						
	Facilities	0 sf	1,500 sf	0 sf	1,500 sf	0 sf
	Mail Room	0 sf	1,800 sf	0 sf	1,800 sf	0 sf
Student Activities						
	Bookstore	0 sf	2,100 sf	0 sf	2,100 sf	0 sf
	Campus Ministries	0 sf	150 sf	0 sf	150 sf	0 sf
	Campus Radio	0 sf	950 sf	0 sf	950 sf	0 sf
	Campus Store	0 sf	2,600 sf	0 sf	2,600 sf	0 sf
	Food Services	0 sf	18,000 sf	0 sf	18,000 sf	0 sf
	Lounge Space	0 sf	9,000 sf	0 sf	9,000 sf	0 sf
	Student Center & Activities	0 sf	16,500 sf	0 sf	16,500 sf	0 sf
Student Services						
	Career Center	0 sf	3,600 sf	0 sf	3,600 sf	0 sf
	Innovation Center	0 sf	6,000 sf	0 sf	6,000 sf	0 sf
	Center for Student Involvement	0 sf	2,350 sf	0 sf	2,350 sf	0 sf
	Counseling	0 sf	0 sf	0 sf	0 sf	0 sf
Technology						
	Academic Computing	0 sf	900 sf	0 sf	900 sf	0 sf
	Total Support Space	**0 sf**	**NA**	**0 sf**	**69,050 sf**	**0 sf**
	Building Total Assignable Square Feet	**0 sf**	**NA**	**0 sf**	**69,050 sf**	**0 sf**
	Anticipated Gross Square Feet			0 sf	127,870 sf	0 sf

ReCap

Berkshire Hall	*43,287 sf*		*51,908 sf*	*51,225 sf*	*66,100 sf*
Student Center (Existing)	*48,185 sf*		*64,550 sf*	*48,181 sf*	*56,975 sf*
New Academic Building	*0 sf*		*54,975 sf*	*0 sf*	*49,150 sf*
New Student Center	*0 sf*		*0 sf*	*69,050 sf*	*0 sf*
Total Assignable Square Feet	*91,472 sf*		*171,433 sf*	*168,456 sf*	*172,225 sf*
Assessment for Midtown Campus (ASF)			*28,586 sf*	*28,586 sf*	*28,586 sf*
Adjustment for Science Building (ASF)			*13,500 sf*	*13,500 sf*	*13,500 sf*
Total Added Assignable Square Feet			*42,086 sf*	*42,086 sf*	*42,086 sf*
Adjustment Total for Buildings Studied			*133,558 sf*	*133,558 sf*	*133,558 sf*
Overage ASF			37,875 sf	34,898 sf	38,667 sf

Westside Scenarios Revised

Category, School & Department		Existing Assignable Square Feet	Programmatic Need	Scenario 1: New School of Business; WS Clrm Used by VPA	Scenario 2: New School of Business; New VAC	Scenario 3: New School of Business; New VAC	Scenario 4: New School of Business; New VAC (Expanded)
Visual & Performing Arts Center							
Academic Space							
School of Visual & Performing Arts							
	Art	18,120 sf	30,278 sf	0 sf	0 sf	0 sf	0 sf
	Music	15,554 sf	30,080 sf	30,000 sf	30,000 sf	30,000 sf	30,000 sf
	Theater	6,042 sf	12,253 sf	9,600 sf	9,600 sf	9,600 sf	9,600 sf
	Total Academic Space	**39,716 sf**	**72,610 sf**	**39,600 sf**	**39,600 sf**	**39,600 sf**	**39,600 sf**
Support Space							
Administrative Service							
	Dean of Visual Performing Arts	590 sf	750 sf	750 sf	750 sf	750 sf	750 sf
Assembly & Exhibition Space							
	Art	1,671 sf	1,800 sf	0 sf	0 sf	0 sf	0 sf
	Music	12,536 sf	13,500 sf	13,500 sf	13,500 sf	13,500 sf	13,500 sf
	Theater	18,435 sf	19,600 sf	19,600 sf	19,600 sf	19,600 sf	19,600 sf
Campus Services							
	Facilities	369 sf	369 sf	369 sf	369 sf	369 sf	369 sf
	Life Safety	154 sf	154 sf	154 sf	154 sf	154 sf	154 sf
Hosted Entities							
	Ives Concert Park	0 sf	500 sf	500 sf	500 sf	500 sf	500 sf
	Total Support Space	**33,755 sf**	**36,673 sf**	**34,873 sf**	**34,873 sf**	**34,873 sf**	**34,873 sf**
	Building Total Assignable Square Feet	**73,471 sf**	**109,283 sf**	**74,473 sf**	**74,473 sf**	**74,473 sf**	**74,473 sf**

Westside Scenarios Revised

Category, School & Department		Existing Assignable Square Feet	Programmatic Need	Scenario 1: New School of Business; WS Clrm Used by VPA	Scenario 2: New School of Business; New VAC	Scenario 3: New School of Business; New VAC	Scenario 4: New School of Business; New VAC (Expanded)
Westside Classroom Building (Demolished In Scenario 2 & Scenario 3)							
Academic Space							
	Classroom Space	11,373 sf	7,705 sf	3,500 sf	0 sf	0 sf	0 sf
	Computer Lab	2,783 sf	6,500 sf	0 sf	0 sf	0 sf	0 sf
Ancell School of Business							
	Accounting	731 sf	2,184 sf	0 sf	0 sf	0 sf	0 sf
	Business	1,223 sf	4,266 sf	0 sf	0 sf	0 sf	0 sf
	Finance	1,978 sf	3,729 sf	0 sf	0 sf	0 sf	0 sf
	Justice & Law Administration	2,302 sf	6,298 sf	0 sf	0 sf	0 sf	0 sf
	Management Info Systems	2,179 sf	3,019 sf	0 sf	0 sf	0 sf	0 sf
	Marketing	1,204 sf	3,188 sf	0 sf	0 sf	0 sf	0 sf
School of Arts & Science							
	Computer Science	3,340 sf	0 sf	0 sf	0 sf	0 sf	0 sf
School of Professional Studies							
	Education & Ed. Psychology	5,437 sf	0 sf	0 sf	0 sf	0 sf	0 sf
	Gen. Use (Conference, Off, Lounge)	725 sf	0 sf	0 sf	0 sf	0 sf	0 sf
School of Visual & Performing Arts							
	Art	0 sf	30,278 sf	30,300 sf	0 sf	0 sf	0 sf
	Music	0 sf	0 sf	0 sf	0 sf	0 sf	0 sf
	Theater	0 sf	0 sf	0 sf	0 sf	0 sf	0 sf
	Total Academic Space	**33,275 sf**	**NA**	**33,800 sf**	**0 sf**	**0 sf**	**0 sf**
Support Space							
Administrative Service							
	Dean of Ancell School of Bus.	966 sf	1,600 sf	0 sf	0 sf	0 sf	0 sf
	Education & Professional Studies	845 sf	0 sf	0 sf	0 sf	0 sf	0 sf
Assembly & Exhibition Space							
	General Use (Class, Seminar)	2,069 sf	2,069 sf	0 sf	0 sf	0 sf	0 sf
	Gallery	0 sf	1,800 sf	1,800 sf	0 sf	0 sf	0 sf
	University Community	2,872 sf	2,872 sf	0 sf	0 sf	0 sf	0 sf
Campus Services							
	Facilities	1,135 sf	1,135 sf	1,100 sf	0 sf	0 sf	0 sf
Hosted Entities							
	Ives Concert Park	424 sf	500 sf	500 sf	500 sf	500 sf	500 sf
	Women's BDC	192 sf	350 sf	0 sf	0 sf	0 sf	0 sf
Library							
	Library	4,149 sf	5,500 sf	5,500 sf	0 sf	0 sf	0 sf
Student Activities							
	Bookstore	1,036 sf	1,036 sf	1,200 sf	1,200 sf	1,200 sf	1,200 sf
	Food Services	361 sf	361 sf	700 sf	0 sf	0 sf	0 sf
	Student Lounge	2,465 sf	2,465 sf	2,500 sf	0 sf	0 sf	0 sf
Technology							
	Academic Computing	2,915 sf	2,915 sf	2,915 sf	0 sf	0 sf	0 sf
	Information Technology & Innovation	2,690 sf	2,690 sf	2,690 sf	0 sf	0 sf	0 sf
	Media Services	111 sf	111 sf	111 sf	0 sf	0 sf	0 sf
Vacant		479 sf	0 sf	0 sf	0 sf	0 sf	0 sf
	Total Support Space	**22,709 sf**	**NA**	**17,216 sf**	**1,700 sf**	**1,700 sf**	**1,700 sf**
	Building Total Assignable Square Feet	**55,984 sf**	**NA**	**51,016 sf**	**1,700 sf**	**1,700 sf**	**1,700 sf**

Westside Scenarios Revised

Category, School & Department		Existing Assignable Square Feet	Programmatic Need	Scenario 1: New School of Business; WS Clrm Used by VPA	Scenario 2: New School of Business; New VAC	Scenario 3: New School of Business; New VAC	Scenario 4: New School of Business; New VAC (Expanded)
New School of Business Building							
Academic Space							
	Classroom Space	0 sf	7,705 sf	7,705 sf	7,705 sf	7,705 sf	7,705 sf
	Computer Lab	0 sf	6,910 sf	6,910 sf	6,910 sf	6,910 sf	6,910 sf
Ancell School of Business							
	Accounting	0 sf	2,184 sf	2,200 sf	2,200 sf	2,200 sf	2,200 sf
	Finance	0 sf	3,729 sf	3,800 sf	3,800 sf	3,800 sf	3,800 sf
	Justice & Law Administration	0 sf	6,298 sf	6,300 sf	6,300 sf	6,300 sf	6,300 sf
	Management	0 sf	4,266 sf	4,300 sf	4,300 sf	4,300 sf	4,300 sf
	Management Info Systems	0 sf	3,019 sf	3,100 sf	3,100 sf	3,100 sf	3,100 sf
	Marketing	0 sf	3,188 sf	3,200 sf	3,200 sf	3,200 sf	3,200 sf
	Total Academic Space	**0 sf**	**NA**	**37,515 sf**	**37,515 sf**	**37,515 sf**	**37,515 sf**
Support Space							
Administrative Service							
	Dean of Ancell School of Bus.	0 sf	1,600 sf	1,600 sf	1,600 sf	1,600 sf	1,600 sf
Assembly & Exhibition Space							
	Multipurpose Space	0 sf	2,500 sf	4,500 sf	4,500 sf	4,500 sf	4,500 sf
Centers & Institutes							
	Centers & Institutes	0 sf	1,800 sf	1,800 sf	1,800 sf	1,800 sf	1,800 sf
Campus Services							
	Facilities	0 sf	750 sf	750 sf	750 sf	750 sf	750 sf
Hosted Entities							
	Ives Concert Park	0 sf	500 sf	0 sf	0 sf	0 sf	0 sf
	Women's BDC	0 sf	350 sf	350 sf	350 sf	350 sf	350 sf
Library							
	Library	0 sf	5,500 sf	0 sf	5,500 sf	0 sf	0 sf
Student Activities							
	Bookstore	0 sf	0 sf	0 sf	0 sf	0 sf	0 sf
	Food Services	0 sf	900 sf	900 sf	900 sf	900 sf	900 sf
	Student Lounge	0 sf	2,500 sf	2,500 sf	2,500 sf	2,500 sf	2,500 sf
Technology							
	Academic Computing	0 sf	2,915 sf	0 sf	0 sf	0 sf	0 sf
	Information Technology & Innovation	0 sf	2,690 sf	0 sf	0 sf	0 sf	0 sf
	Media Services	0 sf	111 sf	0 sf	0 sf	0 sf	0 sf
Vacant		0 sf	0 sf	0 sf	0 sf	0 sf	0 sf
	Total Support Space	**0 sf**	**NA**	**12,400 sf**	**17,900 sf**	**12,400 sf**	**12,400 sf**
	Building Total Assignable Square Feet	**0 sf**	**NA**	**49,915 sf**	**55,415 sf**	**49,915 sf**	**49,915 sf**
	Gross Square Feet			92,435 sf	102,620 sf	92,435 sf	92,435 sf

Westside Scenarios Revised

Category, School & Department		Existing Assignable Square Feet	Programmatic Need	Scenario 1: New School of Business; WS Clrm Used by VPA	Scenario 2: New School of Business; New VAC	Scenario 3: New School of Business; New VAC	Scenario 4: New School of Business; New VAC (Expanded)
New Visual Arts Center							
Academic Space							
School of Visual & Performing Arts							
	Art	0 sf	30,278 sf	0 sf	36,000 sf	36,000 sf	42,000 sf
	Music	0 sf	30,080 sf	0 sf	0 sf	0 sf	6,000 sf
	Theater	0 sf	12,253 sf	0 sf	0 sf	0 sf	3,000 sf
	Total Academic Space	**0 sf**	**72,610 sf**	**0 sf**	**36,000 sf**	**36,000 sf**	**51,000 sf**
Support Space							
Administrative Service							
	Dean of Visual Performing Arts	0 sf	0 sf	0 sf	0 sf	0 sf	0 sf
Assembly & Exhibition Space							
	Art (Galley)	0 sf	1,800 sf	0 sf	1,800 sf	1,800 sf	1,800 sf
Library							
	Library	0 sf	5,500 sf	0 sf	0 sf	5,500 sf	5,500 sf
Student Activities							
	Food Services	0 sf	0 sf	0 sf	0 sf	0 sf	0 sf
	Bookstore (C Store Concept)	0 sf	0 sf	0 sf	1,500 sf	1,500 sf	1,500 sf
	Student Lounge	0 sf	2,500 sf	0 sf	2,500 sf	2,500 sf	2,500 sf
Campus Services							
	Facilities	0 sf	0 sf	0 sf	600 sf	600 sf	600 sf
	Life Safety	0 sf	0 sf	0 sf	0 sf	0 sf	0 sf
	Total Support Space	**0 sf**	**9,800 sf**	**0 sf**	**6,400 sf**	**11,900 sf**	**11,900 sf**
	Building Total Assignable Square Feet	**0 sf**	**NA**	**0 sf**	**42,400 sf**	**47,900 sf**	**62,900 sf**
	Gross Square Feet			0 sf	78,519 sf	88,704 sf	116,481 sf
Expanded Campus Center							
Academic Space							
	Computer Lab	1,200 sf	1,800 sf	1,800 sf	1,800 sf	1,800 sf	1,800 sf
	Total Academic Space	**1,200 sf**	**1,800 sf**	**1,800 sf**	**1,800 sf**	**1,800 sf**	**1,800 sf**
Support Space							
	Assembly & Exhibition Space	7,688 sf	9,000 sf	9,000 sf	9,000 sf	9,000 sf	9,000 sf
	Athletics, Recreation & Phy Ed	1,520 sf	1,520 sf	1,520 sf	1,520 sf	1,520 sf	1,520 sf
	Campus Services	597 sf	750 sf	750 sf	750 sf	750 sf	750 sf
	Food Services	9,213 sf	14,400 sf	14,400 sf	14,400 sf	14,400 sf	14,400 sf
	Student Activities	5,594 sf	7,500 sf	7,500 sf	7,500 sf	7,500 sf	7,500 sf
	Student Services	1,040 sf	2,500 sf	2,500 sf	2,500 sf	2,500 sf	2,500 sf
	Total Support Space	**25,652 sf**	**35,670 sf**	**35,670 sf**	**35,670 sf**	**35,670 sf**	**35,670 sf**
	Building Total Assignable Square Feet	**26,852 sf**	**NA**	**37,470 sf**	**37,470 sf**	**37,470 sf**	**37,470 sf**
	Gross Square Feet *(Addition Only)*			19,663 sf	19,663 sf	19,663 sf	19,663 sf

Westside Scenarios Revised

Category, School & Department	Existing Assignable Square Feet	Programmatic Need	Scenario 1: New School of Business; WS Clrm Used by VPA	Scenario 2: New School of Business; New VAC	Scenario 3: New School of Business; New VAC	Scenario 4: New School of Business; New VAC (Expanded)
ReCap						
Visual & Performing Arts Center	73,471 sf	NA	74,473 sf	74,473 sf	74,473 sf	74,473 sf
Westside Classroom Building (Demolished In Scenario 2 & Scen	55,984 sf	NA	51,016 sf	1,700 sf	1,700 sf	1,700 sf
New School of Business Building	0 sf	NA	49,915 sf	55,415 sf	49,915 sf	49,915 sf
New Visual Arts Center	0 sf	NA	0 sf	42,400 sf	47,900 sf	62,900 sf
Expanded Campus Center	26,852 sf	NA	37,470 sf	37,470 sf	37,470 sf	37,470 sf
Building Total Assignable Square Feet	**156,307 sf**		**212,874 sf**	**211,458 sf**	**211,458 sf**	**226,458 sf**

3. MASTER PLAN COST ESTIMATE

COST ESTIMATE

GENERAL FUND PROJECTS				
Building Projects	Location	BLD GSF	Const. Cost	Project Cost
New Academic Building / Health and Wellness	MT	61,400	$32,664,800	$47,363,960
Student Center Renovation for Academic Use	MT	77,000	$29,481,500	$42,748,175
Relocate Alumni Pavilion	WS	1,600	$100,000	$145,000
New School of Business / Academic Building	WS	103,000	$54,075,000	$78,408,750
O'Neill Center Expansion / Renovation	WS	152,000	$61,848,900	$89,680,905
Westside Athletic Center Expansion	WS	25,000	$5,931,200	$8,600,240
Academic Building II / Visual Arts	WS	86,000	$57,939,000	$84,011,550
Maintenance Facility Expansion, Utility Extension	WS	2,000	$1,264,000	$1,832,800
Subtotal			$243,304,400	$352,791,380
Demolition Projects				
Demolish Westside Classroom Bldg, Create Terraced Quad			$4,126,000	$5,982,700
Circulation, Landscape and Open Space Projects				
North Gateway Transit Hub	MT	n/a	$840,000	$1,092,000
Convert Roach Ave. to Pedestrian Mall	MT	n/a	$2,160,000	$2,808,000
Expand VPAC Lot, Relocate Tennis Courts	WS	n/a	$3,103,000	$4,033,900
Convert Faculty Lot to Landscape Quad	WS	n/a	$3,562,000	$4,630,600
Artificial Turf Field & Lights	WS	n/a	$2,400,000	$3,120,000
Facility and Field Improvements at Existing Baseball field	WS	n/a	$5,100,000	$6,630,000
Reconfigure University Boulevard Parking	WS	n/a	$270,000	$351,000
Subtotal			$17,435,000	$22,665,500
Infrastructure Projects				
Add new 500HP boiler to existing boiler plant		n/a	$1,421,000	$1,634,150
Provide natural gas service to Westside Campus (no equipment)*		n/a	$1,738,000	$1,998,700
Subtotal			$3,159,000	$3,632,850
TOTAL / GENERAL FUND PROJECTS			**$268,024,400**	**$385,072,430**

CHEFA FUNDED PROJECTS				
Building Projects				
Berkshire Addition / Renovation / Innovation Center**	MT	115,000	$59,074,315	$85,657,757
Newbury Hall Renovation	MT	42,600	$9,005,400	$13,057,830
Fairfield Hall Addition	MT	2,500	$2,205,000	$3,197,250
Campus Center Expansion / Renovation	WS	65,000	$32,974,770	$47,813,417
Grasso Hall Renovation	WS	4,000	$1,615,000	$2,341,750
Centennial Hall Renovation (Partial Renovation)	WS	8,500	$4,697,400	$6,811,230
Subtotal			$109,571,885	$158,879,233
Circulation, Landscape and Open Space Projects				
Science Lawn / Recreation Enhancements	MT	n/a	$1,152,000	$1,497,600
Outdoor Recreation, Litchfield Hall	MT	n/a	$1,257,750	$1,635,075
Access Improvements to Centennial Garage	WS	n/a	$296,000	$384,800
Subtotal			$2,705,750	$3,517,475
TOTAL / CHEFA PROJECTS			**$112,277,635**	**$162,396,708**

MT Midtown Campus
WS Westside Campus

* Source: WCSU

* May also include General Fund funding

Western Connecticut State University
Master Plan Scenarios
Conceptual Estimate
22-Dec-16

ESTIMATED COST

AREA	LOC	Proposed Total Area	Proposed Estimated Construction Cost	A - Substructure	B - Shell	C - Interiors	D - Services	D10 - Elevator	D20 - Plumbing	D30 - HVAC	D40 - Fire Protection	D50 - Electrical	E - Equipment	F - Demolition	G - Site (Sitework)	G - Site (Landscape)	Estimated Direct Cost/SF	General Conditions	Construction contingencies	Estimated Bldg. Cost/SF	NOTES
GENERAL FUND PROJECTS																					
Building Projects																					
Berkshire Hall	MT																				
Demolition of existing structure		45,345	1,224,315	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00	2.00	0.00	17.00	23.8%	27.5%	27.00	
Gut Renovation / vacant theater		7,100	2,442,400	10.00	20.00	55.00	0.00	3.00	15.00	55.00	4.50	45.00	7.00	3.00	0.00	0.00	217.50	23.8%	27.5%	344.00	
Refurbish / Gym		10,300	2,513,200	0.00	0.00	40.00	0.00	0.00	6.00	55.00	4.50	30.00	7.00	10.00	2.00	0.00	154.50	23.8%	27.5%	244.00	
New Construction - North Wing		54,600	29,975,400	30.00	105.00	40.00	0.00	3.00	12.00	55.00	4.50	52.00	7.00	3.00	30.00	6.00	347.50	23.8%	27.5%	549.00	
New Construction - Infill & South Wing		43,000	22,919,000	30.00	105.00	40.00	0.00	3.00	12.00	55.00	4.50	52.00	7.00	3.00	20.00	6.00	337.50	23.8%	27.5%	533.00	
New Academic Building / Health and Wellness	MT	61,400	32,664,800	30.00	105.00	40.00	0.00	3.00	12.00	55.00	4.50	52.00	7.00	3.00	20.00	5.00	336.50	23.8%	27.5%	532.00	
Student Center Renovation for Academic Use	MT																				
Gut Renovation		69,000	29,394,000	30.00	50.00	40.00	0.00	3.00	12.00	55.00	4.50	40.00	7.00	3.00	20.00	5.00	269.50	23.8%	27.5%	426.00	
Demolition of existing structure		2,500	87,500	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	2.00	0.00	22.00	23.8%	27.5%	35.00	
Relocate Alumni Pavilion	WS	1,600	310,400	3.75	25.00	0.00	0.00	0.00	0.00	0.00	0.00	30.00	0.00	18.75	15.00	30.00	122.50	23.8%	27.5%	194.00	
New School of Business / Academic Building	WS	103,000	54,075,000	10.00	125.00	40.00	0.00	4.00	20.00	47.00	6.50	40.00	10.00	0.00	20.00	10.00	332.50	23.8%	27.5%	525.00	
O'Neill Center Expansion / Renovation	WS																				
New Construction - Gym		13,500	6,331,500	30.00	70.00	25.00	0.00	12.00	10.00	47.00	5.00	45.00	10.00	5.00	18.00	20.00	297.00	23.8%	27.5%	469.00	
New Construction - Sports Performance		13,500	8,613,000	30.00	125.00	60.00	0.00	5.00	30.00	55.00	5.00	47.00	15.00	2.00	20.00	10.00	404.00	23.8%	27.5%	638.00	
New Construction - Office		7,000	3,591,000	30.00	105.00	40.00	0.00	3.00	12.00	55.00	4.50	40.00	7.00	3.00	20.00	5.00	324.50	23.8%	27.5%	513.00	
New Construction - Public concourse		42,000	27,384,000	30.00	125.00	70.00	0.00	4.00	20.00	60.00	6.00	60.00	10.00	3.00	15.00	10.00	413.00	23.8%	27.5%	652.00	
Renovation, Field House (enclosure only)		37,700	2,714,400	0.00	20.00	0.00	0.00	0.00	0.00	8.00	0.00	15.00	1.50	1.00	0.00	0.00	45.50	23.8%	27.5%	72.00	
Gut Renovation, Fitness area		22,600	9,492,000	3.00	20.00	75.00	0.00	0.00	22.00	50.00	5.00	50.00	20.00	11.00	10.00	0.00	266.00	23.8%	27.5%	420.00	
Gut Renovation, Office area		10,200	3,723,000	0.00	20.00	70.00	0.00	0.00	20.00	50.00	5.00	45.00	10.00	11.00	0.00	0.00	231.00	23.8%	27.5%	365.00	
Westside Athletic Center Expansion	WS																				
New Construction - North		5,400	3,769,200	45.00	175.00	55.00	0.00	0.00	18.00	55.00	5.00	45.00	3.00	11.00	20.00	10.00	442.00	23.8%	27.5%	698.00	
New Construction - Upper Level		1,600	1,832,000	230.00	140.00	60.00	0.00	0.00	25.00	70.00	5.00	65.00	20.00	40.00	40.00	30.00	725.00	23.8%	27.5%	1,145.00	
Renovation - Extg Fabric Roof Replacement		30,000	330,000	0.00	6.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23.8%	27.5%	11.00	
Academic Building II / Visual Arts	WS	89,000	57,939,000	40.00	130.00	50.00	0.00	4.00	18.00	50.00	5.00	45.00	10.00	0.00	50.00	10.00	412.00	23.8%	27.5%	651.00	
Maintenance Facility Expansion	WS	2,000	1,264,000	40.00	80.00	30.00	0.00	0.00	10.00	40.00	5.00	35.00	0.00	0.00	150.00	10.00	400.00	23.8%	27.5%	632.00	
Subtotal		670,345	302,589,115																		
Demolition Projects																					
Demolish Westside Classroom Bldg / Open Space Restoration																					
Demolish Westside Classroom Bldg		88,000	2,376,000	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.25	1.00	0.00	14.00	1.25	0.00	16.76	23.8%	27.5%	27.00	
Create Open space		25,000	1,750,000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.00	0.00	8.00	28.00	44.00	23.8%	27.5%	70.00	
Subtotal		113,000	4,126,000																		
Circulation, Landscape and Open Space Projects																					
North Gateway Transit Hub	MT	15,000	840,000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	10.00	20.00	35.00	23.8%	27.5%	56.00	
Convert Roach Ave. to Pedestrian Mall	MT	30,000	2,160,000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00	0.00	0.00	0.00	30.00	45.00	23.8%	27.5%	72.00	
Expand VPAC Lot, Relocate Tennis Courts	WS	107,000	3,103,000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	14.00	1.00	18.00	23.8%	27.5%	29.00	
Convert Faculty Lot to Landscape Quad	WS	137,000	3,562,000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	6.00	5.00	16.00	23.8%	27.5%	26.00	
Artificial Turf Field & Lights	WS	100,000	2,400,000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	2.00	10.00	15.00	23.8%	27.5%	24.00	
Facility and Field Improvements at Existing Baseball field	WS	150,000	5,100,000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	19.00	21.00	23.8%	27.5%	34.00	
Reconfigure University Boulevard Parking	WS	15,000	270,000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	3.00	5.00	11.00	23.8%	27.5%	18.00	
Subtotal		554,000	17,435,000																		
Infrastructure Project																					
Add new 500HP boiler to existing boiler plant																					
New 500 HP boiler		1,000	1,421,000	0.00	0.00	25.00	0.00	0.00	20.00	750.00	0.00	60.00	0.00	45.00	0.00	0.00	900.00	23.8%	27.5%	1,421.00	
Provide natural gas service to Westside Campus (no equipment)*		1,000	1,738,000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1,101.00	0.00	1,101.00	23.8%	27.5%	1,738.00	
Subtotal		1,000	3,159,000																		
CHEFA FUNDED PROJECTS																					
Building Projects																					
Newbury Hall Renovation																					
Gut Reno - Level 2 & 3		17,000	5,253,000	5.00	20.00	40.00	0.00	0.00	12.00	55.00	4.50	40.00	7.00	12.00	0.00	0.00	195.50	23.8%	27.5%	309.00	

Western Connecticut State University
Master Plan Scenarios
Conceptual Estimate
22-Dec-16

ESTIMATED COST

AREA	LOC	Proposed Total Area	Proposed Estimated Construction Cost	A - Substructure	B - Shell	C - Interiors	D - Services	D10 - Elevator	D20 - Plumbing	D30 - HVAC	D40 - Fire Protection	D50 - Electrical	E - Equipment	F - Demolition	G - Site (Sitework)	G - Site (Landscape)	Estimated Direct Cost/SF	General Conditions	Construction contingencies	Estimated Bldg. Cost/SF	NOTES
Minor Refurb/Improvements		22,000	2,640,000	0.00	0.00	25.00	0.00	0.00	3.00	12.00	3.00	25.00	3.00	5.00	0.00	0.00	76.00	23.8%	27.5%	120.00	
Gut Reno - Level G		3,600	1,112,400	5.00	20.00	40.00	0.00	0.00	12.00	55.00	4.50	40.00	7.00	12.00	0.00	0.00	195.50	23.8%	27.5%	309.00	
Fairfield Hall Addition		2,500	2,205,000	40.00	250.00	50.00	0.00	0.00	20.00	45.00	6.50	55.00	2.00	25.00	40.00	25.00	558.50	23.8%	27.5%	882.00	
Campus Center Expansion / Renovation																					
New Construction - North		3,200	2,787,200	30.00	250.00	60.00	0.00	0.00	20.00	70.00	4.50	60.00	7.00	25.00	20.00	5.00	551.50	23.8%	27.5%	871.00	
New Construction - Roof terrace		1,000	217,000	30.00	60.00	0.00	0.00	0.00	12.00	0.00	0.00	20.00	0.00	15.00	0.00	0.00	137.00	23.8%	27.5%	217.00	
New Construction - North		14,800	9,412,800	25.00	150.00	45.00	0.00	0.00	18.00	60.00	4.50	50.00	10.00	20.00	15.00	5.00	402.50	23.8%	27.5%	636.00	
Gut Renovation, Level 01, Kitchen		7,985	3,585,265	8.00	20.00	50.00	0.00	0.00	15.00	80.00	6.50	30.00	62.62	12.00	0.00	0.00	284.12	23.8%	27.5%	449.00	
Gut Renovation, Level 02		4,000	2,096,000	15.00	30.00	80.00	0.00	4.00	35.00	75.00	6.50	55.00	15.00	12.00	2.00	2.00	331.50	23.8%	27.5%	524.00	
Gut Renovation, Level 03		2,000	1,078,000	15.00	30.00	80.00	0.00	4.00	35.00	75.00	6.50	55.00	25.00	12.00	2.00	2.00	341.50	23.8%	27.5%	539.00	
Gut Renovation, balance of extg building		32,315	13,798,505	5.00	25.00	65.00	0.00	4.00	25.00	65.00	6.50	55.00	4.00	12.00	2.00	2.00	270.50	23.8%	27.5%	427.00	
Grasso Hall Renovation (partial)		1,670	835,000	0.00	30.00	100.00	0.00	0.00	30.00	70.00	6.50	55.00	10.00	15.00	0.00	0.00	316.50	23.8%	27.5%	500.00	
Mechanical Room expansion (no equipment)		2,000	780,000	0.00	80.00	30.00	0.00	0.00	10.00	30.00	6.50	40.00	0.00	10.00	30.00	10.00	246.50	23.8%	27.5%	390.00	
Centennial Hall Renovation (partial)																					
Level 02 - Gut Renovation		2,638	1,134,340	0.00	10.00	80.00	0.00	0.00	20.00	60.00	5.00	50.00	7.00	12.00	20.00	8.00	272.00	23.8%	27.5%	430.00	
Level 02 - New Construction		2,900	2,276,500	35.00	200.00	80.00	0.00	0.00	20.00	60.00	5.00	50.00	7.00	12.00	20.00	8.00	497.00	23.8%	27.5%	785.00	
Level 01 - Gut Renovation		2,992	1,286,560	0.00	10.00	80.00	0.00	0.00	20.00	60.00	5.00	50.00	7.00	12.00	20.00	8.00	272.00	23.8%	27.5%	430.00	
Subtotal			50,497,570																		
Circulation, Landscape and Open Space Projects																					
Science Lawn / Recreation Enhancements	MT	36,000	1,152,000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	14.00	20.00	23.8%	27.5%	32.00	
Outdoor Recreation, Litchfield Hall	MT	29,250	1,257,750	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00	0.00	0.00	6.00	5.98	26.98	23.8%	27.5%	43.00	
Access Improvements to Centennial Garage	WS	8,000	296,000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	3.00	23.00	23.8%	27.5%	37.00	
Subtotal		73,250	2,705,750																		

General Conditions including the following:

General Conditions, CMR	10.00%
General Requirements, CMR	4.50%
Insurances & bonds	4.25%
Permits	2.53%
Total for above General Conditions, CMR	21.28%
CMR Fee	2.50%

Construction Contingencies

Design/Estimating Contingency	25.00%
CMR Contingency (Carried by CMR)	2.50%
Construction Contingency (Carried by Owner)	Excluded
Escalation	Excluded

Project Cost Contingencies (Added to construction costs)

Project cost mark-ups on building projects	45.00%
Project cost mark-ups on non-building projects	30.00%
Project cost mark-ups on infrastructure projects	15.00%

4. ENERGY MASTER PLAN

TABLE OF CONTENTS

3. ENERGY NEEDS

3.1 FUTURE DEVELOPMENT

3.2 ENERGY RESILIENCY RECOMMENDATIONS

4. CONCLUSION / NEXT STEPS

4.1 CONTACT INFORMATION FOR KEY STAKEHOLDERS

APPENDICES

APPENDIX A
APPENDIX B

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

The Western Connecticut State University (Western) Energy Master Plan aims to identify ways Western can improve energy use on campus, and be an active participant in Connecticut State Colleges & Universities (CSCU)'s energy management, reduction and conservation efforts. Western has been active in completing energy-related upgrades, and focusing on energy improvements. The utility data received indicates Western is a medium performing CSCU University from an energy perspective (see Figure 1 Western Energy Dashboard). The energy use intensity (EUI) method is used for benchmarking and comparison purposes.

Figure 1a: Site and Source EUI by Campus

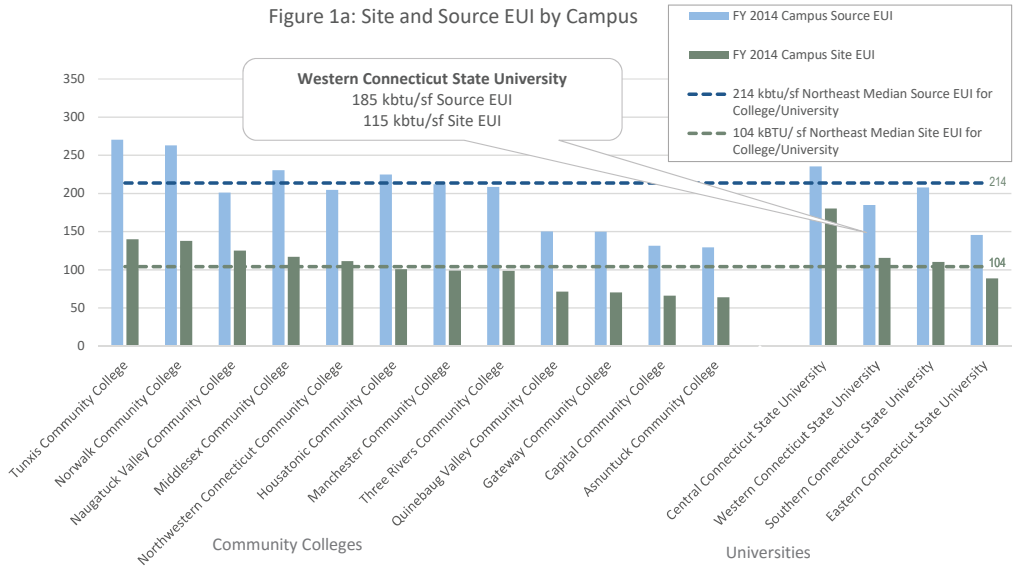

Figure 1b: Campus Energy Use by Type (FY 2014)

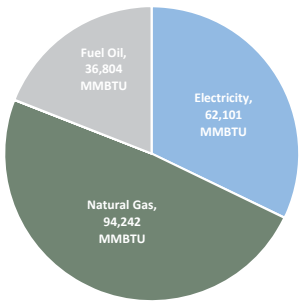

Figure 1c: Campus Weather Normalized Site EUI by Fiscal Year

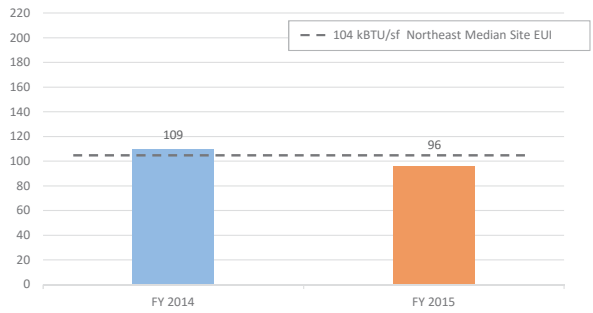

Figure 1d: Site EUI by Building (FY 2014)

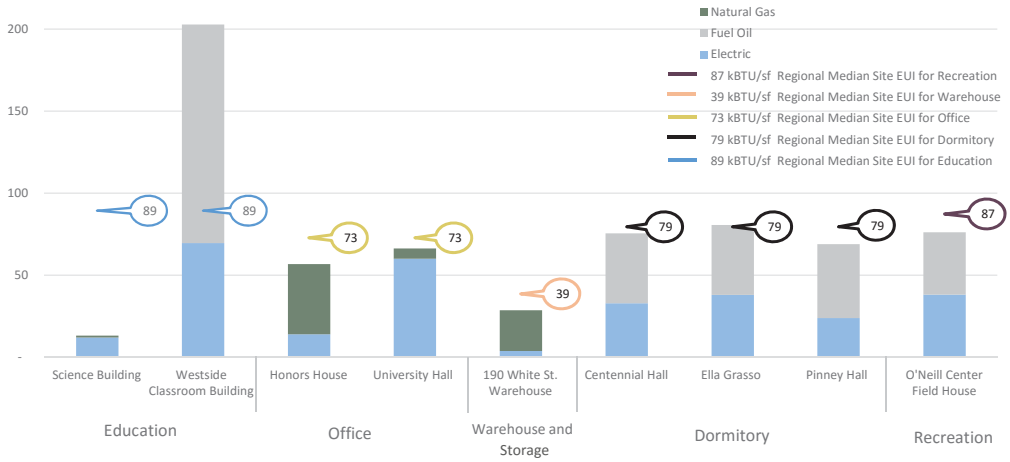

FIGURE 1: Western Connecticut State University Energy Dashboard

* Only buildings with both electricity and fuel submetering data are shown
** Note The Science Building's heating and electricity are largely provided by a 400 kW fuel cell. The EUI does not reflect the building consumption of the fuel cell's generation as separate metered data is not available at this time

Energy Spending

Table 1 provides a summary of energy spending compared to the average of CSCU campuses and the Northeast Region Commercial Sector.

	Western Connecticut State University	Average of CSCU University	Average of CSCU Community College	Northeast Region Commercial Sector
Cost per Square Feet	$ 2.42	$ 2.04	$ 2.49	$ 1.67 [1]
Cost per FTE Student	$ 900	$ 677.00	$ 311	$ -
Avg. Cost per kWh Electricity from Grid	$ 0.14	$ 0.14	$ 0.14	$ 0.15 [2]
Avg. Cost per MMBtu Natural Gas	$ 8.43	$ 7.32	$ 10.06	$ 10.03 [3]
Total Operating Expenses	$ 127,325,717	$ -	$ -	
Total Energy Spending	$ 4,449,692	$ -	$ -	
% of Operating Expenses	3.49%	2.67%	1.92%	

TABLE 1: Energy Cost Comparison (FY 2014)

[1] Energy $/sf in the Northeast region from CBECS 2012 report; education building type - *http://www.eia.gov/consumption/commercial/data/2012/c&e/cfm/c6.cfm*
[2] Electricity $/kWh in the Northeast region from EIA Electric Power Monthly June 2014 - *http://www.eia.gov/electricity/monthly/current_year/june2014.pdf*
[3] Natural gas $/MMBtu in the Northeast region from EIA Connecticut Price of Natural Gas - *http://www.eia.gov/dnav/ng/hist/n3020ct3m.htm*

Utility Incentives/ Develop Plan for Energy Efficiency Measures (EEMs)

Both of Western's utilities are through Eversource. This places the campus in a prime position to maximize incentives by combining multiple energy saving opportunities in what is known as a "Comprehensive Project."

Since incentives are based on incremental energy savings, further analysis and collaboration with Eversource is required to determine rebate amounts for each opportunity. Table 2 demonstrates a summary of the EEMs recommended for Western to pursue.

Opportunity ID	Energy Conservation or Efficiency Opportunity	Associated Building if Applicable	App. Cost (Before Rebate)	Payback w/rebate (Years)	Priority
WCSU-1	Optimize fuel cell operations and ensure REC payments are received.	Fuel Cell	Engineering/ Administration Time	Instantaneous	1
WCSU-2	Continue to pursue connecting the Westside Campus to Natural gas.	Westside	$1.5 Million	3.5	1
WCSU-3	Pursue Solar PV PPA	Multiple, presented in Renewable Energy Section	PPA	PPA	1
WCSU-4	Continue to recommission existing buildings every 3-5 years. (Consult with Eversource). Focus on buildings using a strategy identified in the Energy Master Plan.	All	$0.50 - $3.50 / sf	Varies	Varies
WCSU-5	Program energy submetering historian to store at least one year's data from district steam loop so total building energy use can be calculated and archive annually after review. Existing JCI EMS can be used.	Midtown	Minimal	Varies	1
WCSU-6	Retrocommission Boiler House to manage flow and/or return temperatures, adding or tuning temperature resets.	Central Plant	Varies	<1 - 3	1
WCSU-7	Continue to coordinate operations scheduling with consolidating building occupants.	All	Varies	Varies	1
WCSU-8	Explore reducing boiler system pressure further from 80 psi based on outdoor air temperature. Refer to the DOE Best Practices Steam Technical Brief http://www.nrel.gov/docs/fy06osti/37853.pdf	Midtown	Minimal	Instantaneous	1
WCSU-9	Further insulate piping, focusing first on steam, including fittings and valves.	Midtown	$ 65,000	<1 - 3	1

WCSU-10	Explore a steam trap maintenance program, either automatic, such as Armstrong Steam-Eye, or perform at least an annual survey of all steam traps using ultrasonic or other means of detecting failed traps. (Consult with Eversource for a free/heavily subsidized audit)	Midtown	Minimal	<1 - 2	1
WCSU-11	Consult with Eversource to update lighting in Garage to LED.	White Street Parking Garage	$50,000 - $150,000	1.2 - 2.5	1
WCSU-12	Conduct a comprehensive lighting audit.	Campus-Wide	Varies (Possibly Free)	1 - 3	2
WCSU-13	Install individual thermostats on steam radiators.	Old Main, Higgins Hall	$160 - $315 per thermostat	1 - 5	2
WCSU-14	Insulation: Conduct EBCx for building envelope on buildings built before 1980, or for buildings with obvious deficiencies such as ice dams and drafts. Insulation should exceed latest building code or ASHRAE 90.1 standard.	White Hall	Varies	Varies	2
WCSU-15	Convert pneumatic controlled HVAC systems to DDC.	Old Main, Higgins, White Hall, Berkshire Hall, Westside Building, Ella Grasso Dormitory	$2.50 - $5 /sf	Varies	2
WCSU-16	Investigate alternative energy system such as district ground source geothermal system (closed loop).	Westside	Varies	Varies	3
WCSU-17	Monitor wind incentive programs for Westside Campus.	Westside	-	-	3
WCSU-18	Monitor Fuel Cells/CHP for Westside Campus (certain fuel cells may not need a thermal load).	Westside Campus	-	-	3

TABLE 2: Western Recommended Select Energy Efficiency Measures

Next Steps

Management

Western should continue to review energy spend, including tracking building level energy use with Utility Direct and comparing energy spend to available budgets. The campus should also pursue building shut downs and consolidations during Winter break, to the extent possible.

Alternative Energy

Explore Power Purchase Agreements (PPAs) for rooftop solar and/or ground mounted arrays. Western should work with the System Office to explore PV options. CSCU has received favorable pricing for PPA projects with possible discounts of 20% to 50% of purchased power costs. Western may consider monitoring for wind turbine incentives, and possibly evaluate wind feasibility.

Western should also consider pursuing natural gas service on the Westside Campus, given energy cost savings, and a lower environmental impact. For Western's fuel cell, Facilities should investigate whether Renewable Energy Credits (RECs) are being secured.

By implementing the suggestions of the Energy Master Plan, Western has the opportunity to create local and cost-effective power through solar PV and changing energy sources to increase energy efficiency operations, and continue to manage energy as the campus evolves in the future.

INTRODUCTION

As part of the Connecticut State Colleges & Universities (CSCU) Energy Master Plan, Western Connecticut State University (Western)'s building infrastructure, energy use and energy management practices were assessed. The ultimate goal was to determine ways Western could improve its energy use on campus, and be an active participant in CSCU energy reduction efforts. This chapter identifies Western's historical energy use, future projected needs and energy recommendations.

1.1 WESTERN OVERVIEW

Western is a public university, serving approximately 5,826 undergraduate and graduate students. Western prides itself on its intimate classroom settings, with a student faculty to ratio of 13.8 to 1. In the fall of 2015, Western's Instructional Faculty consisted of 205 full-time and 388 part-time staff. Western's total workforce is 1,118 people.

Western has two campuses; Midtown, the 34-acre main campus in Danbury, and Westside, a 364-acre campus located approximately three miles from the main campus. The Midtown Campus is the original campus, located at 181 White Street near the Main Street Historic District in downtown Danbury, and is home to most of the University's administration as well as the School of Arts and Sciences and the School of Professional Studies. The campus includes three residence halls - Fairfield Hall, Litchfield Hall, and Newbury Hall. The Midtown Student Center, Connecticut's first state-funded LEED building and the Ruth Haas Library are located on this campus .

FIGURE 1.1: Western Connecticut State University

Western's Central Heating Plant, located on the Midtown campus in the same building as the police department, provides HVAC capabilities to the Midtown campus in conjunction with a few individual heating systems. To increase performance, Western replaced the Central Heating Plant's two boilers in 2012. In 2013, a new fuel cell began operation to provide heat and electricity to the Science Building.

The Westside campus, situated on the outskirts of Danbury, was purchased in the 1970s. The campus includes the Ancell School of Business, student Campus Center, nature center, amphitheater, three residence halls, playing fields, and athletic facilities. A new LEED Silver Visual and Performing Arts (VPA) Center opened in the Fall of 2014. There are future plans to further expand the campuses' assets with a new police station and residence hall.

Western's campuses encompass 29 owned buildings. A list of campus buildings is included in Table 1.1.

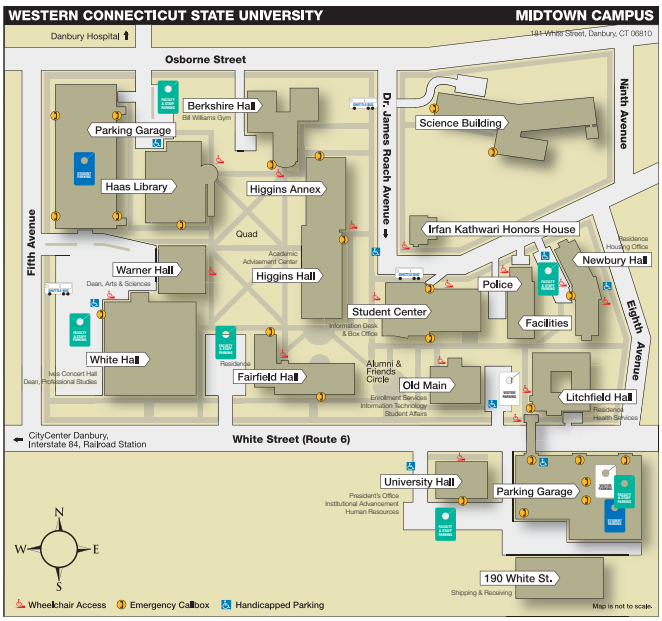

FIGURE 1.2: Western Midtown Campus

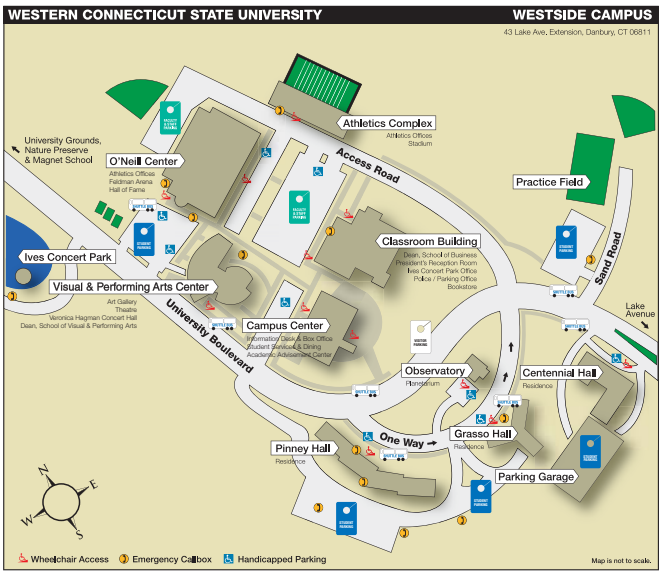

FIGURE 1.3: Western Westside Campus

Campus	Building	Year Built [Renovated]	Gross Square Feet	Building Function
Midtown	190 White St. Warehouse	1983	56,732	Warehouse and Storage
Midtown	Berkshire Hall	1958	84,796	Mixed Use
Midtown	Boiler Plant/Police/Trades	1959	10,773	Facilities
Midtown	Higgins Hall	1950	85,674	Academic
Midtown	Honors House	1932	8,434	Office/Administration
Midtown	Ives Concert Hall		2,500	Other
Midtown	Midtown Student Center	1959 [1998]	71,880	Mixed Use
Westside	Observatory	1995	2,694	Other
Midtown	Old Main Administration Building	1904	42,207	Office/Administration
Westside	O'Neill Center Field House	1994	167,581	Athletics
Midtown	Ruth Haas Library	1969[2000]	113,021	Library
Midtown	Science Building	2005	111,542	Academic
Midtown	University Hall	1984	20,302	Office/Administration
Westside	Visual and Performing Arts Center	2014	137,330	Other
Midtown	Warner Hall	1999 [2006]	34,078	Office/Administration
Westside	Western Athletic Complex	2004	18,273	Recreation
Westside	Westside Campus Center	2007	49,074	Mixed Use
Westside	Westside Classroom Building	1981	96,110	Academic
Westside	Westside Maintenance Facility	1998	2,566	Other
Midtown	White Hall	1925	133,869	Academic
Subtotal			**1,249,436**	
Residential Buildings				
Westside	Centennial Hall	2004	131,038	Residence Hall
Westside	Ella Grasso Dormitory	1983	78,811	Residence Hall
Midtown	Fairfield Hall	1927 [2008]	45,231	Residence Hall
Midtown	Litchfield Hall	1964-1966	53,357	Residence Hall
Midtown	Newbury Hall	1969	60,158	Residence Hall
Westside	Pinney Hall	1999	193,772	Residence Hall
Residence Hall Subtotal			**562,367**	
Building Total GSF			**1,811,803**	
Garages				
Westside	Centennial Parking Garage	2004	138,215	Parking Garage
Midtown	Midtown/5th St/Student Parking Garage	2006	257,500	Parking Garage
Midtown	White Street Parking Garage	1996	215,421	Parking Garage
Parking Garage Subtotal			**611,136**	

TABLE 1.1: Western Campus Building Information

1.2 PREVIOUS ENERGY STUDIES & PROJECTS

According to Western, approximately a third to two thirds of the buildings on the two campuses have been audited. The campus has also strategically implemented the following measures:

- Lighting retrofits,
- Energy efficiency upgrades,
- Expanded building automation and controls,
- HVAC system renovations that provide access to natural gas as an alternative to oil use at most Midtown campus buildings,
- Boiler replacements,
- Demand Response, and
- Energy monitoring

Western has completed extensive building automation system (BAS) optimization actions since 2007, totaling over $3 million in savings to date.* Western was also recently recognized for environmental responsibility with the 2015 Green Award by the Morris Media Group.** The group commended Western for energy reduction in Pinney Hall, facilitated by investing over $450,000 in smart-building technology. Other accomplishments related to achieving LEED Silver status for the VPA building and installation of four electric vehicle (EV) charging stations. Western's efforts continue to exemplify a commitment to energy conservation and efficiency.

* \\wc\shared\projects\228934 Perkins+Will - CSCU Energy Master Plan\wip\CSCU info\Western\Energy\Energy Info\Energy Projects\Past Projects\WCSU List of Past Projects from EnerNOC.xlsx
** Hill, Sherri. "WCSU earns 2015 Green Award from Morris Media Group," 2015. Web. http://www.wcsu.edu/facilities/pdfs/WCSUearns2015GreenAwardfromMorris%20MediaGroup.pdf

EXISTING CONDITIONS & RECOMMENDATIONS

Information on Western's existing conditions was captured from campus interviews, energy data and reports provided by the campus. A holistic view of existing practices, material on energy management, energy infrastructure and project implementation processes was reviewed. Analysis of the data and campus walkthroughs helped clarify recommendations with the goal of decreasing energy use, documented after each subheading.

2.1 FACILITY ENERGY BENCHMARKING AND ENERGY CONSUMPTION

The energy dashboard in Figure 2.1 provides an overview of Western's energy use, based on fiscal year 2014 and 2015 data. These results are intended to be indicative of general performance only and not by any means directly correlated to absolute performance given that each campus has different academic uses, occupancy patterns and program goals. The utility data received indicates Western is performing at the average of the CSCU campuses from an energy perspective. Recently installed condensing gas domestic hot water boilers at the Midtown campus are expected to further reduce the campus EUI. Western's site EUI of 155 kbtu/ sq ft is above the Northeast median for colleges/universities.

Figure 2.1a: Site and Source EUI by Campus

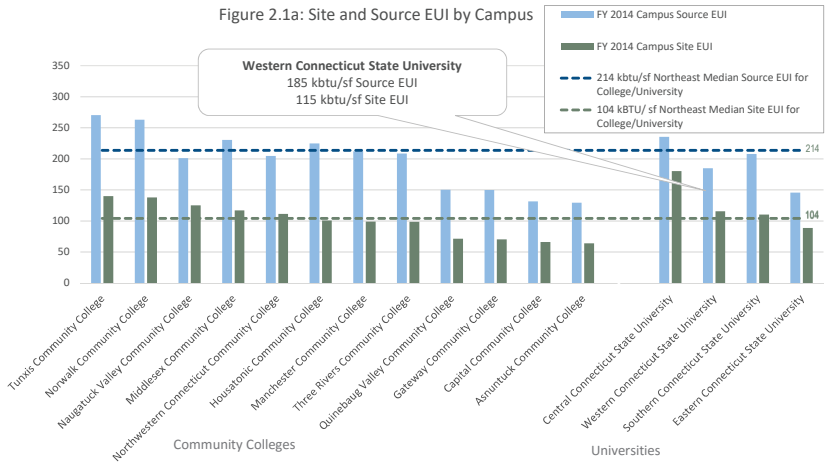

Figure 2.1b: Campus Energy Use by Type (FY 2014)

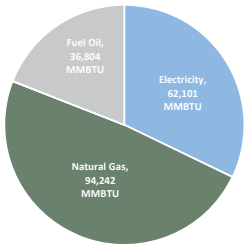

Figure 2.1c: Campus Weather Normalized Site EUI by Fiscal Year

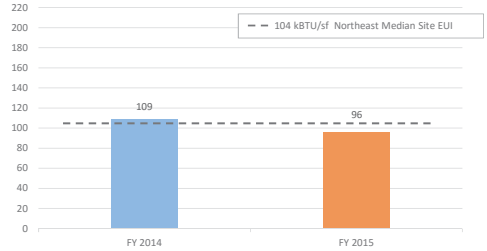

Figure 2.1d: Site EUI by Building (FY 2014)

FIGURE 2.1: Western Connecticut State University Energy Dashboard

* Only buildings with both electricity and fuel submetering data are shown
** Note The Science Building's heating and electricity are largely provided by a 400 kW fuel cell. The EUI does not reflect the building consumption of the fuel cell's generation as separate metered data is not available at this time.

Figure 4 in the energy dashboard, displays campus site EUIs for the buildings with full metering data, with the exception of the Science Building in which the EUI does not include fuel cell generation metering. Aside from the Westside Classroom Building, each of the buildings with available EUI data are less than the regional median site EUI for the same building type. The Westside Classroom Building relies on fuel oil for heating which contributes to more than half of the EUIs. Other than the Westside Classroom Building, the data suggests Western is performing well.

While each building at Western has its own electric and gas account, those that rely on steam or hot water heating are not displayed in the EUI in Figure 4. The fuel use for the buildings on steam or hot water are not a clear indicator of actual energy use since the steam from the Central Plant is not metered.

Table 2.1 provides a comparison of FY 2014 energy spending compared to the average of CSCU campuses and the Northeast Region Commercial Sector.

Energy spending per gross square foot (GSF) per year for each building with full submetering is broken out in Figure 2.2. If a building is not shown, energy submetering is recommended to complete the total energy use profile for each building.

While most of Western's data are consistent with or below the average of the CSCU campuses, the cost per FTE is approximately 50% more than the average of the other CSCU universities. This may be attributed in part to Western's expansive campus and use of higher cost fuel oil for the Westside Campus. Buildings such as residence halls with longer operational schedules than academic or administrative buildings, along with various summer programs, cause the universities in general to have higher costs per FTE student than community colleges.

2.2 CAMPUS UTILITIES AND DISTRIBUTION

Western consumes primarily three energy sources- electricity, natural gas and fuel oil. There is limited propane and diesel use as well. The Midtown campus buildings are distributed from the central steam plant, operating on natural gas. The Westside Campus buildings are heated by distributed systems fueled by oil, since the Westside campus does not currently have any access to natural gas.

	Western Connecticut State University	Average of CSCU University	Average of CSCU Community College	Northeast Region Commercial Sector
Cost per Square Feet	$ 2.42	$ 2.04	$ 2.49	$ 1.67 [1]
Cost per FTE Student	$ 900	$ 677.00	$ 311	$ -
Avg. Cost per kWh Electricity from Grid	$ 0.14	$ 0.14	$ 0.14	$ 0.15 [2]
Avg. Cost per MMBtu Natural Gas	$ 8.43	$ 7.32	$ 10.06	$ 10.03 [3]
Total Operating Expenses	$ 127,325,717	$ -	$ -	
Total Energy Spending	$ 4,449,692	$ -	$ -	
% of Operating Expenses	3.49%	2.67%	1.92%	

TABLE 2.1: Energy Cost Comparison (FY 2014)

[1] Energy $/sf in the Northeast region from CBECS 2012 report; education building type - *http://www.eia.gov/consumption/commercial/data/2012/c&e/cfm/c6.cfm*
[2] Electricity $/kWh in the Northeast region from EIA Electric Power Monthly June 2014 - *http://www.eia.gov/electricity/monthly/current_year/june2014.pdf*
[3] Natural gas $/MMBtu in the Northeast region from EIA Connecticut Price of Natural Gas - *http://www.eia.gov/dnav/ng/hist/n3020ct3m.htm*

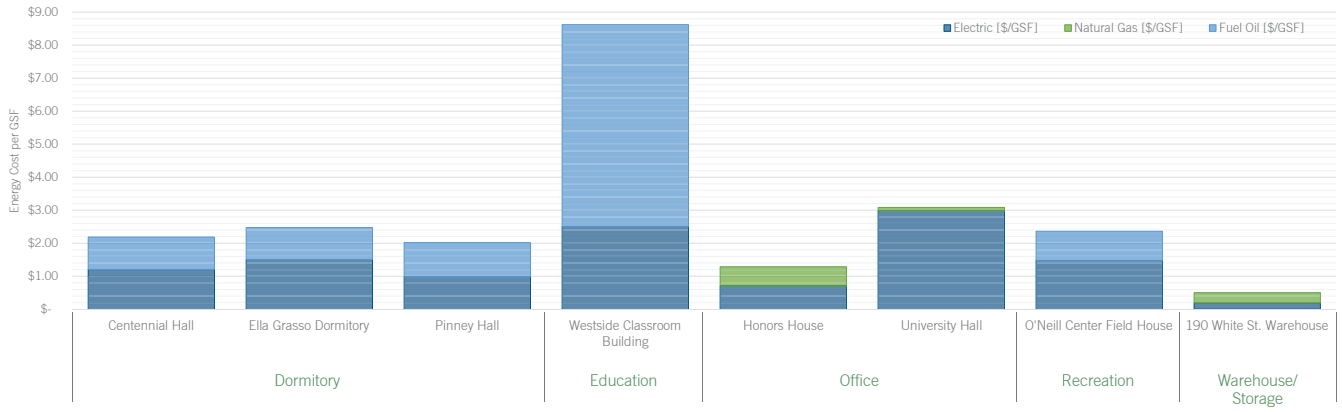

FIGURE 2.2: Western FY14 Energy Cost per GSF by Building Type

Note: Buildings missing from the graph do not have available submetering. To complete a total energy use profile, energy submetering is recommended.

There is no central cooling on either campus. Western's utility providers include:

Electricity: Eversource, formerly Connecticut Light & Power

Natural Gas: Eversource, formerly Yankee Gas

Fuel Oil: Dime Oil

Propane: Leahy Fuels

From a long-term strategic standpoint, Western should switch from fuel oil to natural gas on the Westside Campus. The campus is recommended to switch to natural gas for a number of reasons:

- Lower carbon energy source than fuel oil
- Typically, lower cost per MMBTU of natural gas compared to fuel oil
- Eliminates maintenance costs associated with oil heat

  a. Can eliminate holding tanks for fuel oil storage requirements (if not using dual fuel)

  b. Eliminates the need for trucking fuel deliveries
- Enables the use of more widely available, higher efficiency condensing boilers

In 2016, Western commissioned a study with Eversource to expand its existing natural gas infrastructure in Waterbury up to the University Boulevard. Eversource estimated the project would require approximately $1 million for the 2.5 mile expansion onto the campus, and another $500,000 for the remaining one mile of service and necessary building conversions.

From a cost standpoint, the price of fuel oil has dropped substantially, yet is still more costly per unit than natural gas. Based on FY 14 and FY 15, the unit price of fuel oil on an MMBTU basis approximately halved while the cost of natural gas increased. Annual savings based on FY 2015 natural gas unit costs are approximately $245,000.

FY 14 and FY 15 Western Fuel Oil Costs; Projected Savings

Fiscal Year	2014	2015
Fiuel Oil Use (MMBTU)	36,804	44,121
$/MMBTU	$ 33.62	$ 16.78
Total Cost	$ 1,142,794	$ 684,880
Savings based on Fiscal Year Natural Gas Cost	$ 927,093 ($8.43/MMBTU)	$ 244,872 ($11.23/MMBTU)

TABLE 2.2: FY 14 and FY 15 Western Fuel Oil Costs; Projected Savings

Consideration of this investment depends on future oil and gas prices, and cannot be determined with certainty. The U.S. Energy Information Administration (EIA) provides short-term, with the most current analysis projecting until 2017, and long term price projections.

In the latest 2016 Annual outlook, EIA projects prices out to 2040. Figure 2.3 represents expected pricing trends for natural gas and oil based on long-term commercial costs. In the reference case, the figure demonstrates an increasing price gap between natural gas and fuel oil into the long-term. As is the case with Western, while fuel oil prices did see a significant drop in the past year, fuel oil prices are expected to rebound. By the end of 2040, commercial New England natural gas prices are projected to increase by 0.7%, while distillate commercial oil prices are projected to experience a 2.4% price increase.

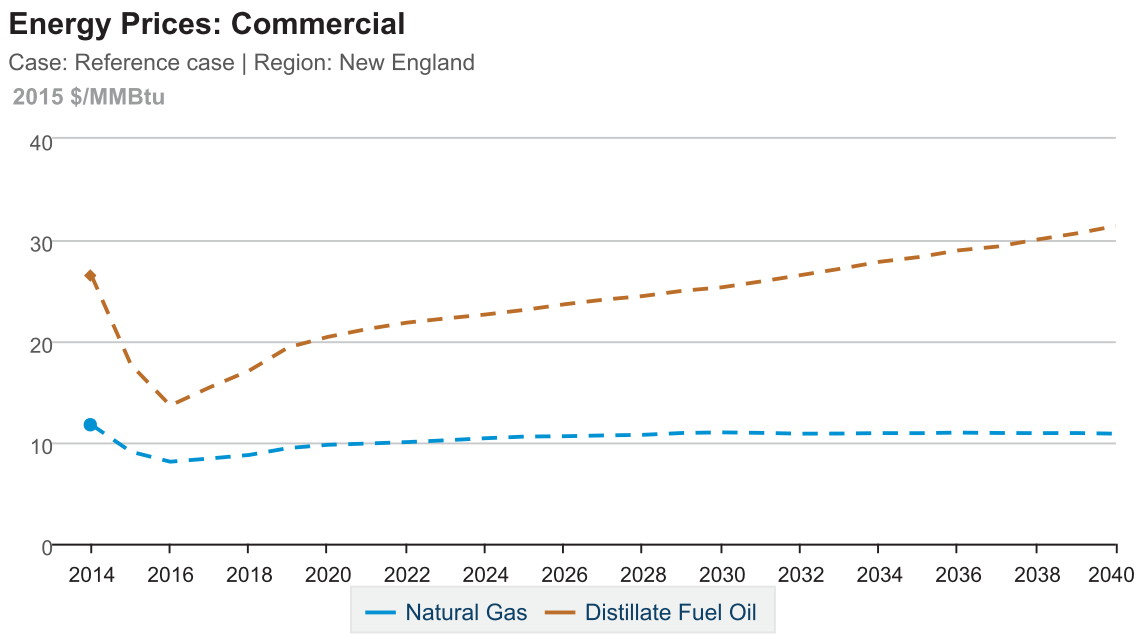

FIGURE 2.3: Projected New England Fuel Prices Over Time Based EIA Reference Case

EIA project pricing is based on geopolitical scenarios, supply and demand, technology developments, policy changes and numerous other scenarios. As Figure 2.4 demonstrates, even in the low fuel oil cost reference case, the cost of fuel oil still surpasses natural gas by at least $3/MMBTU. The scenario reflects a case in which there is slower economic growth, less consumption, less travel and other factors resulting in lower demand for liquid fuels and a higher supply.

In all cases of the Annual Outlook natural gas prices are lower than oil prices.

Given the price disparity, it is likely that by switching to natural gas, Western could continue to see energy savings.

For the simple payback calculation and to reflect potential changes in prices greater than a one-year short term outlook, the EIA Reference case is used for savings. The percent changes in price in the reference case is applied to the FY15 average fuel oil price for the Westside campus and the FY 15 natural gas use. Based on the data, the simple payback is approximately 3.5 years. (See Table 2.3)

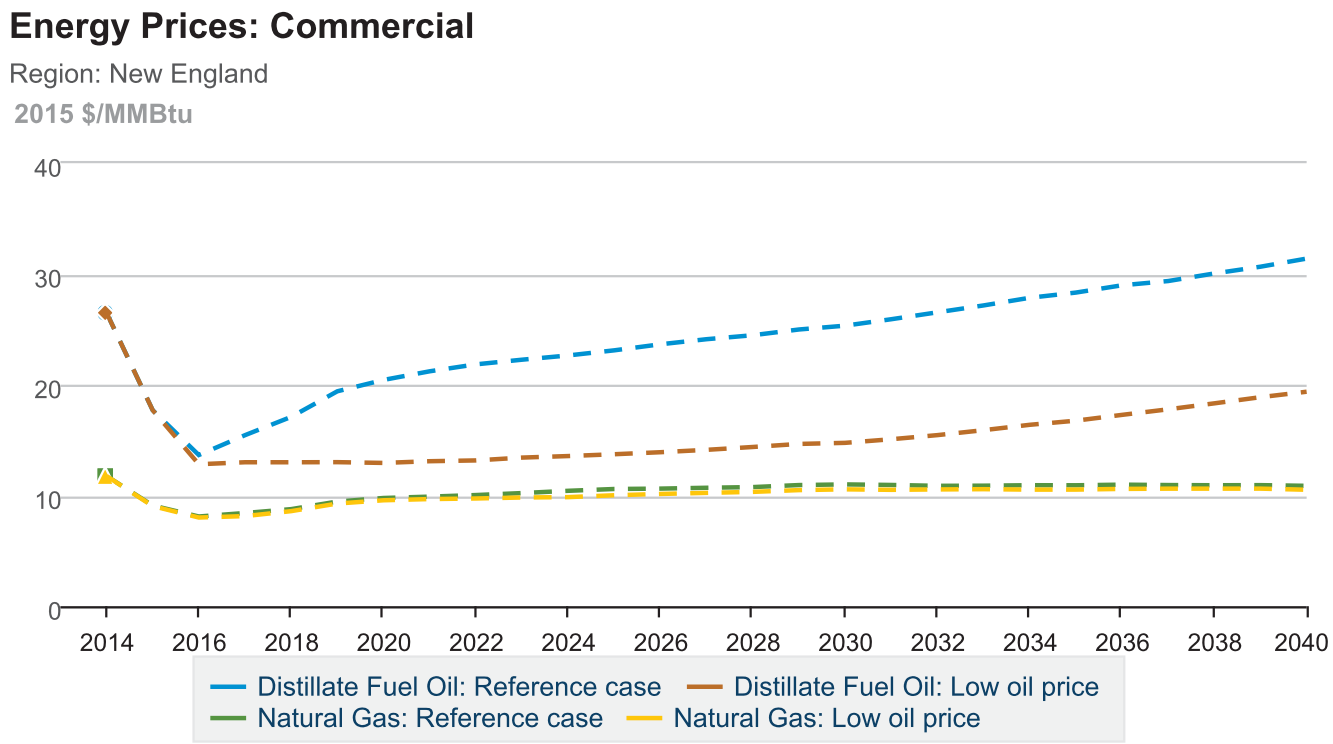

FIGURE 2.4: Comparison of New England Projected Fuel Oil Prices Based on EIA Reference Case and Low Oil Price Scenario

Item	Year		2016	2017	2018	2019	2020	2021
Capital Cost	$	1,500,000	$ 1,500,000	$ 1,500,000	$ 1,500,000	$ 1,500,000	$ 1,500,000	$ 1,500,000
Approximate Savings per Year			$ 329,385	$ 398,804	$ 483,861	$ 520,629	$ 556,053	$ 581,847
Savings to Date/Cash Flow			$ 329,385	$ 728,189	$ 1,212,050	$ 1,732,679	$ 2,288,732	$ 2,870,579
Cumulative Cash flow	$	(1,500,000)	$ (1,170,615)	$ (771,811)	$ (287,950)	$ 232,679	$ 788,732	$ 1,370,579

Payback	3.55

TABLE 2.3: Natural Gas Project Payback with New England EIA Reference Case Prices

Using the low oil price case (the scenario with the lowest cost of fuel oil), payback increases to approximately 6.5 years.

Item	Year		2016	2017	2018	2019	2020	2021	2022	2023
Capital Cost	$	1,500,000	$ 1,500,000	$ 1,500,000	$ 1,500,000	$ 1,500,000	$ 1,500,000	$ 1,500,000	$ 1,500,000	$ 1,500,000
Approximate Savings per Year			$ 252,365	$ 223,848	$ 181,282	$ 158,555	$ 160,771	$ 161,654	$ 593,945	$ 602,434
Savings to Date/Cash Flow			$ 252,365	$ 476,212	$ 657,494	$ 816,049	$ 976,820	$ 1,138,474	$ 1,732,419	$ 2,334,853
Cumulative Cash flow	$	(1,500,000)	$ (1,247,635)	$ (1,023,788)	$ (842,506)	$ (683,951)	$ (523,180)	$ (361,526)	$ 232,419	$ 834,853

Payback	6.61

TABLE 2.4: Natural Gas Project Payback with Low Oil Reference Case Prices

Despite multiple fuel scenarios that EIA presents, natural gas prices are still expected to remain lower than fuel oil. Therefore, the sooner Western switches to natural gas, the more savings the campus is likely to see.

2.3 ENERGY PROCUREMENT

Western is part of the CSCU's 2013 electric supply procurement contract with Direct Energy, formerly Hess Energy, detailed further in the Energy Master Plan. In FY13 Hess Energy was also the natural gas supplier. The local distribution company, Eversource, became Western's supplier in FY14.

2.4 OPERATIONAL AND ENERGY MANAGEMENT PRACTICES

2.4.1 CURRENT CONDITIONS

Western's infrastructure maintenance, improvement, and utility operations are completed under the umbrella of the Division of Facilities Services (Facilities). The Division consists of Environmental Health & Safety (EHS), Facilities Operations, Facilities Planning & Engineering, Facilities Scheduling and Promotion, and the WestConnect Card Office. Maintenance Trades and Minor Capital Projects in the Facilities Operations Department manage minor capital projects and building maintenance, while Facilities Planning & Engineering oversees large construction projects.

Western's campuses are occupied year round, with the exception of Winter Break. The campuses operate on a two semester a year schedule, with three to four summer sessions, campus and other programs during the summer. Facilities does not currently have the ability to schedule building shut downs. During Winter break there are no classes scheduled, but one or two faculty members may use their campus offices or labs. During the winter period, Facilities manages energy by adjusting setbacks and lowering temperatures, but does not shut the buildings down. The heating season begins October 15th and ends April 15th. When the heating season has ended, all heating systems in all buildings are turned off to eliminate standby losses and save energy.

Occupancy greatly fluctuates throughout the week and buildings are not always effectively utilized. An estimated 80% of classrooms are used in a three-day period, rather than all five days of the school week. In particular, students and faculty often use the labs in the science buildings only twice a week. In terms of energy intensity, the Science Building has a low EUI based on utility bills, since the fuel cell covers a large portion of heating and electricity costs. Part of the campus Master planning effort, includes the identification of ways to better utilize existing space.

Western does not have a designated temperature policy, yet tends to keep baseline temperatures between 68-72 °F. Humidity control can be an energy intensive effort and has a large impact on what occupants feel as comfortable in relation to temperature. Humidity problems can stem from numerous issues beyond the scope of this energy review, including but not limited to: too high cooling coils temperatures, or building HVAC systems that may not be setup to control humidity. Correcting any humidity problems leading to indoor air quality (IAQ) concerns such as mold should be addressed first. IAQ and air change rates have typically defaulted to ASHRAE 90.1, which is the energy standard for all buildings except for low-rise residential.

ENERGY USE INFORMATION MANAGEMENT SYSTEMS

The Facilities Division monitors and manages energy use and infrastructure improvement through several management systems. Facilities implements a work-order management system, Maintenance Direct, which allows University faculty and staff to request and track maintenance work. Most buildings have some controls through the campuses' BAS, Johnson Controls. New buildings have full BAS coverage.

For energy data tracking, most buildings at Western are individually metered. Each building account is linked through a SchoolDude UtilityDirect module. The module contains reporting features to filter by energy type as well as track all utility costs and consumption, and present data based on cost per square foot, building totals, cost budgets and multiple other features. In this way, Western's Facility staff are generally apprised of energy spending.

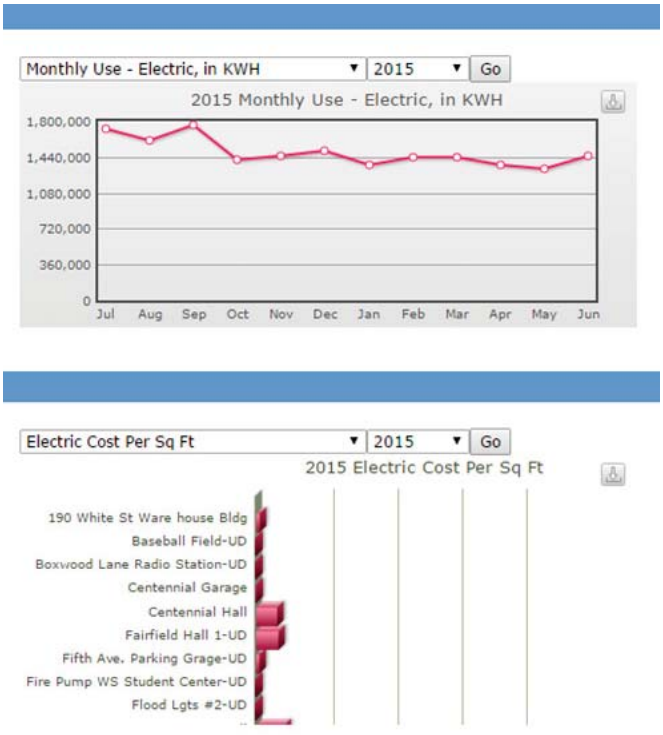

FIGURE 2.5: UtilityDirect Dashboard

From 2004 until the beginning of January 2016, Western had a partnership with EnerNOC for energy scheduling, work order management, and daily monitoring. Western used EnerNOC's PowerTrack platform for 15 buildings. More information about the partnership and results are presented in the Collaboration/ Partnerships section.

EnerNOC had controllers on the JCI infrastructure, drawing all data and reading it. Some buildings which still use pneumatics are unable to benefit from the advantages including monitoring and controling the BMS with DDC provide.

2.4.2 RECOMMENDATIONS

Western does a good job of staying apprised of building data and needs through the use of several energy and infrastructure software platforms. To the extent possible, Facilities should consider executing shut backs and building shut downs during Winter break. Conversations may want to be broached with administration to consolidate faculty members in need of office space during the winter break. Now that EnerNOC is no longer viewing daily energy use, a current staff member or outside resource should to be tasked with monitoring and tracking consumption of various buildings using Utility Direct.

As part of the CSCU Energy Master Plan recommendations in Section 5.2.2, the System Office should create a template for energy tracking applicable to all campuses. Western should use this template to track energy over time rather than viewing energy use through bills only.

ASHRAE 90.1 is an excellent resource to reference for standards relating to design and operation. Alongside 90.1, ASHRAE 62.2 for IAQ should also be referenced. Always reference the most up-to-date edition as research is updating recommended ventilation flow rates and practices with each release.

2.5 EXISTING BUILDING COMMISSIONING

2.5.1 CURRENT CONDITIONS

Western implemented numerous continuing commissioning through EnerNOC. In 2008, the Association of Energy Engineers honored Western with an Energy Project Award for Innovative Retrocommissioning. Over the four-year period, the campuses' 14 identified energy efficiency measures resulted in natural gas and electricity costs savings in excess of $90,000* . As of 2016, Western secured an estimated $598,000 in annualized cost savings resulting from calibration, controls, scheduling and mechanical-related energy efficiency measures. (See Table 2.5) With most low-hanging energy opportunities tackled, recent efforts with EnerNOC have seen diminishing or limited returns and therefore the partnership has been discontinued.

	Count of Equipment	Sum of Annualized Electricity Savings 9kWh)	Sum of Annualized Thermal Energy Savings (100,000 BTU)	Sum of Annualized Cost Savings	Sum of Savings to Date
Calibration	35	25,219	-	$ 4,035	$ 19,203
Control	139	419,819	103,887	$ 193,913	$ 412,017
Mech.	44	548,168	15,172	$ 112,358	$ 463,231
Schedule	34	845,686	125,415	$ 288,345	$ 2,152,625
Total	252	1,839,074	244,473	$ 598,651	$ 3,047,076

TABLE 2.5: Western Past Projects and Associated Savings

A summary of the past projects and savings associated are shown in Table 2.5.

2.5.2 RECOMMENDATIONS

Buildings with BMS with measurable points stand to benefit the most from recommissioning. Although Western does not have a BMS, Western may benefit from manually checking all systems, especially actuators and pneumatic valves, to ensure they operate as intended. As a general rule of thumb, retrocommissioning existing building systems should occur every 3-5 years.

2.6 MECHANICAL SYSTEMS

2.6.1 CURRENT CONDITIONS

Western has two completely independent campuses, each with its own unique energy systems. A summary of the heating and cooling systems for both campuses is provided in Table 2.6..

WESTSIDE CAMPUS

The Westside campus is limited to fuel oil or electricity as a source of heat, although most of the existing boilers are setup for dual fuel should there be a future natural gas connection. Dual fuel boilers are usually not designed for condensing operation and therefore achieve efficiencies in the 80-88% range. Each building has its own independent heating system with no district heating loop in place.

Cooling is supported by a combination of chilled water (CHW) systems, direct expansion (DX) coolers, or less efficient window mounted AC units. There is also no district cooling loop.

MIDTOWN CAMPUS

*Energy Vortex "Western Connecticut State University Receives Energy Project Award for Innovative RetroComissioining," 2008. Web. Western Award for Innovative RetroCommissioning - EnergyVortex.pdf

	Name	Gross S.F.	Fuel EUI (Btu/GSF)	Heating				Cooling				Heat Pump
				Heating Plant Steam	Local Heating System	Electric Heat	None	CHW System	DX System	Window AC Units	None	
Midtown Campus	Berkshire Hall	84,796										
	Boiler House	10,773										
	Ruth Haas Library	113,021										
	Higgins Hall	85,674										
	Honors House	8,434	43									
	Old Main Administration Building	42,207										
	Science Center	111,542										
	Midtown Student Center	71,880	41									
	University Hall	20,302	6									
	Warner Hall	34,078										
	White Hall	133,869										
	190 White St. Warehouse	56,732	25									
	Fairfield Hall	45,231										
	Litchfield Hall	53,357										
	Newbury Hall	60,158										
	White St. Parking Garage	257,500										
	Midtown/5th St/Student Parking Garage	215,421										
Westside Campus	Western Athletic Complex	18,273										
	Westside Campus Center	49,074										
	Westside Classroom Building	96,110	133									
	O'Neill Center Field House	167,581	38									
	Visual and Performing Arts Center	137,330										
	Observatory	2,694										
	Westside Maintenance Facility	2,566										
	Centennial Hall	131,038	43									
	Ella Grasso Dormitory	78,811	42									
	Pinney Hall	193,772	45									
	Centennial Parking Garage	138,215										

TABLE 2.6: Western Existing Building Systems Summary

The Midtown campus has a central plant, known as the Boiler House, which produces 80-100 psig steam. The Boiler House has two (2) dual fuel 500 HP boilers, installed in the Fall 2012, to replace boilers which were fifty-years old. One original Bigelow 525HP boiler remains as only a backup. Maintenance Direct lists seven boiler rooms in total. Six of the boiler rooms are located at the Midtown campus and the last is at the Danbury Armory. It is unknown why all boilers do not appear in Maintenance Direct.

The steam from the boilers is converted to hot water in most buildings through heat exchangers. Some buildings use the high pressure steam directly. Recent reports indicate only 80% of the steam mass leaving the boilers returns as condensate. While some steam is used for humidification, a higher return rate is expected with losses due to blow down and venting which should only be a few percent. Steam traps are common maintenance challenges where in-house maintenance staff are responsible. The domestic hot water system is a stand-alone loop. All underground piping is direct burial.

Cooling is supported by a combination of CHW, DX, and window AC units with no central chiller for district cooling. In 2013, a fuel cell was installed which provides electricity and heat for the Science Building at the Midtown campus.

2.6.2 RECOMMENDATIONS

The following recommendations would aid in optimizing efficiency and reducing energy consumption.

BOILER SYSTEMS

- Move forward with connecting the Westside campus to natural gas. For any new construction, consider installing condensing natural gas boilers which can achieve efficiencies greater than 90%, as compared to oil boilers which do not often exceed 85%.
- Include boilers systems in recommissioning efforts. Temperature resets and hot water flow rates should all be considered and lowered as much as possible while still meeting building heating and domestic hot water needs, and manufacturers minimum return temperatures for hydronic systems.
- Include all valves and fittings when insulating, with priority for hotter, larger piping.
- Implement a steam trap maintenance program, either automatic such as Armstrong Steam-Eye, or perform at least an annual survey of all steam traps using ultrasonic or other means of detecting failed traps. Steam traps may fail open or closed, either wasting thousands of pounds of steam per month, or rendering steam coils inefficient or ineffective.

a. This EEM often has the most rapid return on investment, even without utility incentives. With the incentives, the cost of the steam trap survey can be 100% covered. The repair of traps can also be substantially covered by the rebate program.

- Install individual radiator thermostats. These can be installed for less than a few hundred dollars each and typically provide 9-15% savings according to a 1995 study paid for by NYSERDA.

FUME HOODS

- Implement a fume hood sash management program to ensure hoods are closed and turned off when not in use.

2.7 LIGHTING

2.7.1 CURRENT CONDITIONS

As a standard practice, Western adds LED fixtures and occupancy sensors in conjunction with renovations. The campuses generally lack BMS controlled lighting.

2.7.2 RECOMMENDATIONS

All lighting upgrades should be coordinated with Eversource to help maximize the return on investment. Western should consider the following recommendations:

- Conduct a lighting and controls audit.
- Continue to add occupancy based lighting (and ventilation) controls during renovations. Prioritize upgrades outside of capital planning when funding is available.
- All exterior lighting should be replaced with LED and have photo sensors installed to replace timers.

2.8 BUILDING ENVELOPE

2.8.1 CURRENT CONDITIONS

Western's Midtown campus has eight buildings that are over 50 years old and listed on the State Register of Historic Places. These buildings include:

- Old Main Administration Building
- White Hall
- Fairfield Hall
- Higgins Hall
- Berkshire Hall
- Boiler Plant (has been since updated)
- Midtown Student Center
- Honors House

In 1979, Connecticut legislated its first energy-related state wide standards for buildings, with 1981 as its implementation year. Therefore, for buildings constructed prior to 1981, it is assumed there is limited insulation, air sealing and other energy-related building envelope features that are now standard practice.

2.8.2 RECOMMENDATIONS

Western should insulate wood frame residential buildings constructed prior to 1981 as they are assumed to not have had to abide by stricter building codes. The following sections provide best practices for building envelopes that can be considered by Western, particularly for the buildings constructed prior to 1981.

- Review and ensure ventilation set points are not excessive per the latest edition of ASHRAE 90.1
- Address air infiltration issues by sealing doors and windows
- Insulate heated garage spaces
- Conduct a thermography study using ASTM C1060 or ISO 6781 of buildings built prior to 1980 to identify where there are defects or a lack of insulation.
- Hire a certified consultant to commission the building envelope for new construction using the National Institute of Building Sciences (NIBS) Guideline 3-2012 to include:

  a. Design & construction document review

  b. Laboratory and/or on site performance verification tests

  c. Construction visual QA/QC Inspections

  1. Air, water, water vapor, and thermal barriers

- Include building envelope in recommissioning activities.

2.9 DISTRICT ENERGY / COGENERATION

2.9.1 CURRENT CONDITIONS

The Boiler House at the Midtown campus is connected to the only district steam loop. The Science Building, originally supplied by the Boiler House, has a 400 kW fuel cell, which now provides a majority of the thermal energy needed by the building.

Both Western and Eastern have the same contract for their fuel cell.

In March 2012, Western entered into a power purchase agreement (PPA) with Doosan Fuel Cell America (Doosan), formerly UTC Power, for a PureCell Model 400 fuel cell located at the Science Center. The same contract was provided for Eastern Connecticut State University's 400 kW fuel cell. Under the 10-year term contract, Western pays a fixed monthly payment of $24,834.

FIGURE 2.6: Western 400 kW Fuel Cell

Contract terms and structuring notes include:

- University personnel are trained and responsible for visually inspecting equipment each day, from outside the fence.
- Doosan will provide information to the University on the fuel cell for educational purposes.
- Doosan provides a guaranteed minimum output (GMO) (Mwh) during the 10-year term as well as a consumption guarantee
- If the kwh output for the year does not meet the total guaranteed minimum output (GMO), Doosan will credit the University one percent of the annual payment for each one percent under delivered. Only a credit will be applied if the lack of output is directly related to the system. If the output surpasses the GMO, the University must then compensate Doosan using the same structure.
- Doosan is responsible for providing Western with a usage report at the end of each calendar year, and Western also has access to usage data online.
- Two days of notice are given prior to maintenance
- The system is set up for net-metering mode

Based on the contract payment details outlined in the CSCU Energy Master Plan, the approximate normalized electrical cost for operation of the fuel cell is $0.158/kWh without the capture of Renewable Energy Credits (RECs). The normalized cost is inclusive of fuel input required, using the guaranteed maximum fuel consumption of 425,790 MMBtu over the term, as well as the minimum electric guarantee. Western's fuel cell has been operating well and with consistent electricity output. It is unclear if the campus is currently receiving RECs.

2.9.2 RECOMMENDATIONS

While the heating season (October 15-April 15) could support up to a 600 kW CHP base load to provide 19,000 therm/month, the lack of any thermal demand for the remainder of the year greatly extends the return on investment of an CHP system. (See Appendix XX for more detail on the high-level screening). A second CHP system should not be considered again until the existing fuel cell is near it's end-of-life.

Meanwhile, recommendations for maximizing savings from the existing fuel cell CHP system consist of the following:

- Ensure REC payments are being recovered by Western

a. Consider domestic hot water, makeup air, or feedwater preheating with excess energy to increase the efficiency.

b. Based on the contract terms, Doosan is responsible for selling the RECs and retains 5% of the revenue

c. 1 MWh of electric output is equivalent to one REC in Connecticut. 2016 market prices for a Class I REC are approximately $32.

2.10 DEMAND RESPONSE

Western was the first state agency in Connecticut to implement a demand response program. The campus reduced building loads for 14 of its biggest energy users, totaling 2.1 MW when demand response days were called.

2.10.1 CURRENT CONDITIONS

In anticipation of hot weather and high humidity days, Western should continue to enact demand response measures, such as equipment shut downs and involve the campuses in these events. As part of EPA's regulations, in order to participate in real time demand response, generators must meet EPA's Tier IV emissions requirements. The requirements place stricter emission guidelines on particulate matter and nitrogen oxides. Western should purchase Tier IV compliant systems for any future generators intended to be used for demand response.

2.11 RENEWABLE ENERGY

2.11.1 CURRENT CONDITIONS

Western does not currently have any renewable energy systems on campus. However, Western has been involved in a solar RFP for a 60 kW solar array, which went out to bid three times. Results in the past were not favorable. As of 2016, Western is involved in a joint RFP with Middlesex in the hopes of generating more

interest for the Connecticut small LREC program. According to the campus, there is preference for purchasing an array rather than leasing, given past unfavorable electricity pricing.

2.11.2 RECOMMENDATIONS

There are several potential opportunities for rooftop solar PV on campus depending on roof age, plans for renovations, and availability of space not encumbered by mechanical equipment. In general, there are opportunities for small sites of less than 200 kW. For ground-mount solar, most of the available land is either tree covered or used for recreational purposes. Tree removal may provide additional opportunities for ground-mount. Solar PV should be incorporated into future capital planning building design.

Table 2.7 provides an overview of the buildings that may be considered for solar PV in the future. Following the table are images of each of the sites.

Building Name	Year Built [Renovated]	GSF [FY 2015]	Building Roof sq. ft.	Roof Install/ Replacement Date	Roof Type	Array Size Potential (kW DC)[1]	Annual Generation Potential (MWh)[2]	Solar Suitability Comments
HIGHER PRIORITY PROJECTS								
Litchfield Hall	1964-1966	53,357	17,786	Planned 2017	Built Up	65-85	85-110	Clear flat roof, about to get a new roof
O'Neill Center (Gymnasium Roof)	1994	167,581	52,100	2014	Membrane	192-250	250-321	Perfect candidate. New roof. PV over gym and pool. Not over lobby bar
Pinney Hall	1999	193,772	32,295	1999	EPDM	119-155	155-199	Ballasted roof needs replacement. Pinney Hall lower parking lot is a possible condidate for PV canopy. (Not the lot adjacent to bldg.)
Westside Campus Center	2007	49,074	24,537	2007	Membrane (25 year life)	90-118	118-151	A good condidate over ballroom. Not over the east end roof
Westside Maintenance Facility	1998	2,566	2,566	N/A	N/A	9-12	12-16	Good candidate but older roof needs replacing
Subtotal		**466,350**	**129,284**			**475-620**	**620-797**	
POTENTIAL/LOWER PRIORITY PROJECTS / TO BE DETERMINED								
Berkshire Hall	1958	84,796	42,398	1971	Built Up	156-204	204-261	Roof near end of life
Centennial Hall	2004	131,038	26,208	2004	Standing seam metal roof	96-126	126-161	Azimuth of roofs not ideal and would cause a 2-5% reduction in output. Standing seam metal roofs can be an advantage in that no roof penetrations are necessary for fastening. However, FM Global must approve.
Ella Grasso Dormitory	1983	78811	15762	2016	Rubber	58-76	76-97	Building has new roof, but many roof prostrisions.
Higging Hall	1950	85,674	28,558		Membrane	TBD		Higgins Annex: Roof needs to be replaced. TBD what the new eqipment will be. Higgins: A lower priority from roof obstructions
Midtown Student Center	1959 [1998]	71,880	25,980			60-78	78-100	The previous solar RFP did not sufficient bidders. Feasible in scale if paired with other roofs.
Midtown /5th Street/Student parking Garage	2006	257,500	67,209			247-323	232-414	TBD if structural capacity; aesthetics OK
Newbury Hall	1969	60,158	12,032	2012/2013	Built Up	44-58	58-74	Scheduled for renovation in approximately 3 years
Ruth Haas Library	1969 [2000]	113,021	18,837	N/A	Built Up / Ballast ED	69-90	90-116	Low priority. Building has multiple levels, and lower levels are in shade
Science Building	2005	111,542	8,316			38-50	50-64	Available area includes only south portion of the building.
University Hall	1984	20,302	5,076		Built Up	19-24	24-31	Low priority. Very small
Warner Hall	1999 [2006]	24,078	11,359		Membrane	42-55	55-70	Low priority. Switchgear on lower floor, little usable roof area for PV
White hall	1925	133,869	30,153	1996 (20+ years)	Built Up	55-72	72-93	Low priority. Flat roof, but many protrusions. Array size factors 40% of total roof area.
White Street parking Garage	1996	215,421	86,132			317-413	413-531	Sized for extra levels, so the load is acceptable.
Subtotal		**157,554**				**1201-1569**	**1569-2012**	
Total		**623,904**				**1676-2189**	**2189-2809**	

TABLE 2.7: Western PV Potential

[1] Default assumption is that 80% of roof area is available for solar PV, or if total PV available space is used then 100% of area is assumed. Buildings with mechanical equipment and other structures located on the roof will have less than 80% available space. Also assumes that each sf of panels can generate between 4.6 and 6 Watts DC (about a third of the PVWatt Output Assumptions). Actual generation values would be calculated if a solar PV study was performed.
[2] Assumes that 80% of roof area is available for solar PV and that each sf of panels can generate between 6 and 7.7 kWh annually (about a third of the PVWatt Output Assumptions). Buildings with mechanical equipment and other structures located on the roof will have less than 80% available space. Actual generation values would be calculated if a solar PV study was performed

FIGURE 2.7: Western Westside Campus Potential Areas for Solar PV

FIGURE 2.8: Western Midtown Campus Potential Areas for Solar PV

WIND POTENTIAL

There may be an opportunity for building-integrated wind at Western. Generally, larger wind installations require wind in the vicinity of at 80 m. Residential or microwind applications can create power over 4 m/s. The map below shows average annual wind speed at 30 m in Connecticut. Locations along the shoreline are considered the most suitable conditions for wind power at that height. The Westside campus is the only location believed to have sufficiently consistent winds to merit a feasibility study, with winds around 4 m/s.

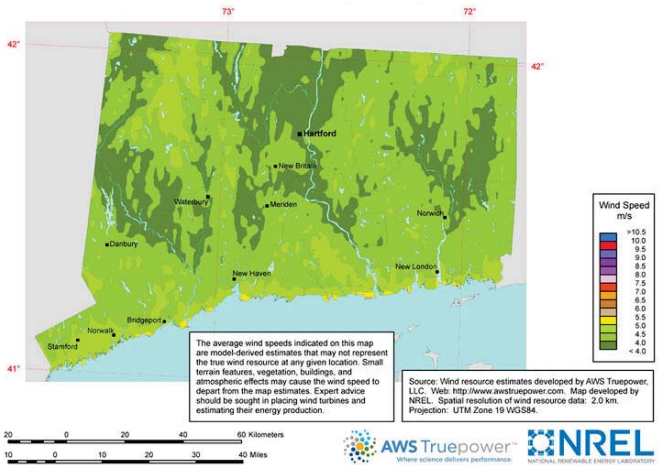

FIGURE 2.9: Connecticut Annual Average Wind Speed at 30m

An example micro turbine is UGE's 1kW Visionair 3, shown below. Based on 4 m/s, a mid-range potential annual output is around 500 kWh. (See Figure 2.11)

FIGURE 2.10: Building Integrated Microturbine

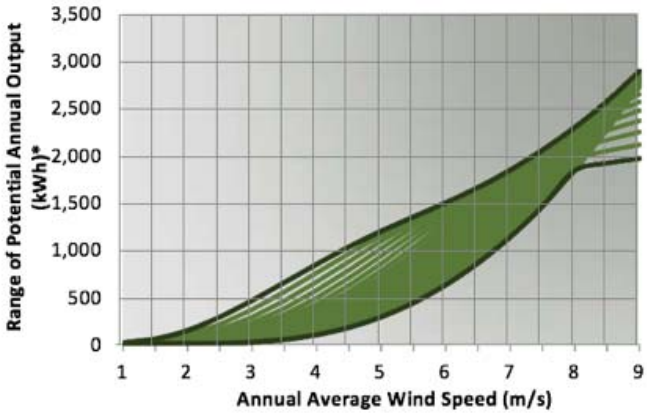

FIGURE 2.11: UGE Visionair3 Potential Annual Output based on Average Annual Wind Speed

Some general guiding principles when considering wind turbine systems, include:

- Wind turbine systems do not typically have a worthwhile ROI. An estimated cost for the UGE Visionaire3 is approximately $18,000- $21,000, inclusive of a ground-mount tower.
- Maintenance costs need to be considered.
- Consider wind turbines if integrated into building design or used as a teaching tool for STEM programs and if at least one years' worth of data can be logged for a specific location
- Wind can be evaluated in special cases, but soft costs are significant to explore these options with limited revenue generation
- Some arrangements of multiple buildings can create a wind tunnel effect and may be worth considering for placement of a vertical axis wind turbine.
- Need to factor zoning regulations.

2.12 CAPITAL PLANNING

2.12.1 CURRENT CONDITIONS

The Facilities Planning and Engineering department of Western's Facilities Services manages capital planning responsibilities, including project financing, master planning, compliance with state standards and construction of capital projects. The Department is guided by the 2007 Campus Master Plan, and the updated Campus Master Plan which align with Western's overall vision and strategic goals. The updated Master Plan provides specific recommendations on space planning and utilization, outside the scope of this project.

On an annual basis, Facilities Services publishes a report on completed Facilities projects, goals and general observations.* The report serves as a reflection on the prior year, and provides a path for improvement for the department. Based on the report, the division has numerous successes including managing over 30 capital projects with budgets totaling $70 million. The department faces challenges stemming from diminishing funds for deferred maintenance, valued at $200 million. While new infrastructure is added, is important that existing energy infrastructure is properly maintained. Despite the shortfall, a capital investment study indicated Western completed maintenance activities at or above peer schools at a lower cost.

Western has expanded its campus significantly in the last few years with the creation of the 137,330 GSF state-of-the-art Visual and Performing Arts Center (VPA) completed in 2014.** The VPA provides a collective space for Western's art, music, and theater arts program. According to the Environmental and Facilities Services Department focus was placed on increasing energy efficiency around Western, allowing the university to absorb energy consumption of the newest VPA building without additional energy cost.

FIGURE 2.12: Western Visual and Performing Arts Center

In fiscal year 2015, Western completed many capital and energy related projects such as the upgrade of the Alumni boiler and Student Center heat exchange rooftop unit, maintenance for Centennial Hall boiler, renovation of the Registrar's Office, Newbury Hall Energy Conservation Project and numerous others.

To accomplish its energy infrastructure goals, Western relies on financing and funding from the System Office and the State. The System Office provides annual code compliance and infrastructure funds. Larger capital projects are also funded under CSCU 2020, as of FY 2015. The State Legislature's Connecticut Health and Educational Facilities Authority (CHEFA) allocates bonds for campus improvement projects.

More information on campus expansion projects is found in Section 3.1

2.12.2 RECOMMENDATIONS

Western does an excellent job of documenting past projects and the status of the Department. In light of decreasing budgets, Western should collaborate with Eversource more heavily for major building renovations, plumbing, electrical, mechanical and new construction.

2.13 COLLABORATION / PARTNERSHIP

2.13.1 CURRENT CONDITIONS

Western has facilitated the implementation of numerous energy projects through strategic partnerships. Western worked with EnerNOC for accomplishing recommissioning and demand response outcomes. Based on the partnership, EnerNOC's tracking estimates over $3 million dollars in savings for the campus.

Western has also worked with Eversource. Western recently initiated a $65,000 steam trap maintenance project including a survey and implementation of recommendations. Eversource is providing 43% of the costs.

For capital projects, Western collaborates with CSCU, the Department of Construction Services and multiple other state agencies to ensure compliance.

2.13.2 RECOMMENDATIONS

Western should continue to work with Eversource to take advantage of Utility Incentives for the EEMs presented in this plan. Incentives structures range and vary by program, but Eversource has offered incentives of up to 80% of project costs in the past.

2.14 SUMMARY OF RECOMMENDED ENERGY EFFICIENCY OPPORTUNITUES

As a result of the campus walk through energy assessment, and interviews with campus staff, a list of potential Energy Efficiency Measures (EEMs) is presented in Table 2.8. These projects represent low cost, immediate action measures, as well as projects that may require larger capital and therefore be longer-term.

Many energy-related projects are incentivized through utility rebates. Both of Western's utilities are through Eversource. This places the campus in a prime position to maximize incentives by combining multiple energy saving opportunities in what is known as a "Comprehensive Project." The primary advantage of a Comprehensive Project is the maximum incentive cap is

* Western Connecticut State University. Facilities Annual Report 2014-2015, 2015.
** Western Connecticut State University. Western's Newest Jewel: the Visual & Performing Arts Center (VPAC). Accessed December 7, 2015. http://www.wcsu.edu/svpa/svpa-center.asp

normally raised from 40% to 50%. Eversource has maximized these incentives in the past, and may also in the future, in the following ways:

- The comprehensive cost cap was increased from 50% to 80% of total cost.
- The incentive was increased from $0.30/kwh or $3.50/CCF (with 40% cost cap) to $0.40/kwh or $4.00/CCF (with 60% cost cap).

Since incentives are based on incremental energy savings; further analysis and collaboration with Eversource will be required to determine rebate amounts for each opportunity. To help Western navigate and prioritize the energy opportunities identified, a summary of opportunities is listed in Table 2.8. Immediate action should be taken to consider priority one and two opportunities with the goal of combining multiple opportunities into a Comprehensive Project. The simple payback in most cases cannot be reasonably estimated without detailed building models and/or more operating data. The payback periods provided are based upon the performance of past similar projects and are not necessarily indicative of future results.

Opportunity ID	Energy Conservation or Efficiency Opportunity	Associated Building if Applicable	App. Cost (Before Rebate)	Payback w/rebate (Years)	Priority
WCSU-1	Optimize fuel cell operations and ensure REC payments are received.	Fuel Cell	Engineering/ Administration Time	Instantaneous	1
WCSU-2	Continue to pursue connecting the Westside Campus to Natural gas.	Westside	$1.5 Million	3.5	1
WCSU-3	Pursue Solar PV PPA	Multiple, presented in Renewable Energy Section	PPA	PPA	1
WCSU-4	Continue to recommission existing buildings every 3-5 years. (Consult with Eversource). Focus on buildings using a strategy identified in the Energy Master Plan.	All	$0.50 - $3.50 / sf	Varies	Varies
WCSU-5	Program energy submetering historian to store at least one year's data from district steam loop so total building energy use can be calculated and archive annually after review. Existing JCI EMS can be used.	Midtown	Minimal	Varies	1
WCSU-6	Retrocommission Boiler House to manage flow and/or return temperatures, adding or tuning temperature resets.	Central Plant	Varies	<1 - 3	1
WCSU-7	Continue to coordinate operations scheduling with consolidating building occupants.	All	Varies	Varies	1
WCSU-8	Explore reducing boiler system pressure further from 80 psi based on outdoor air temperature. Refer to the DOE Best Practices Steam Technical Brief http://www.nrel.gov/docs/fy06osti/37853.pdf	Midtown	Minimal	Instantaneous	1
WCSU-9	Further insulate piping, focusing first on steam, including fittings and valves.	Midtown	$ 65,000	<1 - 3	1
WCSU-10	Explore a steam trap maintenance program, either automatic, such as Armstrong Steam-Eye, or perform at least an annual survey of all steam traps using ultrasonic or other means of detecting failed traps. (Consult with Eversource for a free/heavily subsidized audit)	Midtown	Minimal	<1 - 2	1
WCSU-11	Consult with Eversource to update lighting in Garage to LED.	White Street Parking Garage	$50,000 - $150,000	1.2 - 2.5	1
WCSU-12	Conduct a comprehensive lighting audit.	Campus-Wide	Varies (Possibly Free)	1 - 3	2

WCSU-13	Install individual thermostats on steam radiators.	Old Main, Higgins Hall	$160 - $315 per thermostat	1 - 5	2
WCSU-14	Insulation: Conduct EBCx for building envelope on buildings built before 1980, or for buildings with obvious deficiencies such as ice dams and drafts. Insulation should exceed latest building code or ASHRAE 90.1 standard.	White Hall	Varies	Varies	2
WCSU-15	Convert pneumatic controlled HVAC systems to DDC.	Old Main, Higgins, White Hall, Berkshire Hall, Westside Building, Ella Grasso Dormitory	$2.50 - $5 /sf	Varies	2
WCSU-16	Investigate alternative energy system such as district ground source geothermal system (closed loop).	Westside	Varies	Varies	3
WCSU-17	Monitor wind incentive programs for Westside Campus.	Westside	-	-	3
WCSU-18	Monitor Fuel Cells/CHP for Westside Campus (certain fuel cells may not need a thermal load).	Westside Campus	-	-	3

TABLE 2.8: Western Recommended Select Energy Efficiency Measures

ENERGY NEEDS

3.1 FUTURE DEVELOPMENT

Overall energy use may be impacted by campus expansions and renovations. Western is in the process of developing an updated campus Master Plan to inform future development strategies. The focus of the Master Plan will be on renovations of existing buildings, rather than purely the creation of additional space, which was an objective of the previous 2007 Master Plan. The campus is preparing for multiple potential future capital investments, including:

- **Litchfield Hall renovations** –The 1960 Midtown Campus residence hall is slated for needed upgrades. Renovations will incorporate redesign of common spaces and dorm rooms. The project is intended to meet LEED Silver Certifications. Plans include a requirement for a standby generator and evaluation of life safety system upgrades. The project is in the design phase.

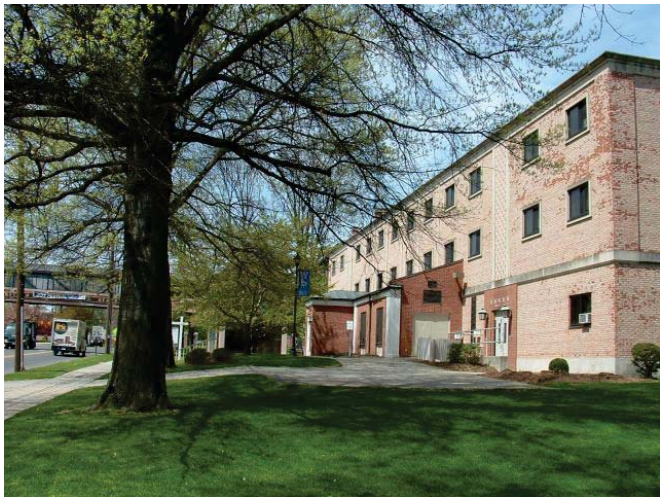

FIGURE 3.1: Litchfield Hall

- **Midtown Campus Police Station** – The current police station is located in the boiler house in an approximately 1,150 square foot addition. The new facility will create a much larger footprint of approximately 8,100 sq. feet. The space will feature multiple office spaces, evidence receiving room, interview rooms, and other facilities imperative to the operation of a police force. The building is projected to meet LEED Silver Certification
- **Higgins Hall Renovation** – The building's current academic spaces and faculty offices are proposed to be reconfigured to meet additional space needs. The renovation will include the addition of a new Academic Success Center. The building will also feature new building systems, including plumbing, HVAC and electrical. An architect has been selected for the work.

There are additional projects in the discussion and planning phases, including a space allocation study for an education/ nursing/business school, a potential new 500-car parking garage, and other renovations. Western has a history of incorporating energy efficient design into planning efforts and should continue to incorporate energy efficient building design into capital planning.

The updated Master Plan will include further objectives for providing the best resources for students; initial long-term project ideas by campus, include:

Midtown Campus

- Boiler House facility equipment renovations and upgrades
- Berkshire Hall demolition of approximately 45,000 GSF and expansion of 97,600 GSF
- New 86,000 GSF Academic Building

Westside Campus

- New 103,000 GSF Academic Building
- New Visual Arts/Academic Building
- O'Neill Center Expansion
- Westside Athletic Complex Expansion
- Westside Campus Center Expansion
- Demolition of the Westside Classroom Building

Please note that these plans are likely to take in excess of 10 years to complete.

As the campuses grow, it is important to be able to support electric and thermal needs of new, as well as existing, buildings. According to a recent infrastructure analysis, the Boiler House is close to capacity. The study projected that additional buildings without expansion of the Boiler House would reduce the redundancy of the plant to lower than the current 75%. Thus, an increase in capacity of the Boiler House is suggested with expansions. Specifically an additional boiler at the Midtown Campus is recommended.

The Westside Campus does not currently have a central plant or natural gas. As a result, with building expansions or new construction, energy efficient local heating and cooling systems are recommended on a local basis.

Ensuring energy reliability through campus expansions is another need. The campus has cited a lack of emergency generator capabilities to run critical equipment on both campuses. As of the FY15 Annual Report, there were plans to purchase Student Center generators.

The Westside Classroom Building has a 1982 365 kW generator that can power only analog systems, and not the necessary power to run electronic systems. A total of eight buildings on campus have generator capabilities:

- Boiler House
- Campus Center
- Fairfield Hall
- Old Main
- Science Center
- Student Center
- University Hall
- Warner Hall

Western should expand its generator capabilities, expand natural gas into the Westside campus, and study the need for additional infrastructure given the numerous additions planned for the campus. With purchases of new generators, Western should pursue Tier IV to be able to use the generators for ISO New England's demand response programs.

Connecticut's Department of Energy & Environmental Protection (DEEP) offers a $10 million microgrid grant program for entities other than municipalities. Western may want consider this program for the future in connection to the fuel cell.

3.2 ENERGY RESILIENCY RECOMMENDATIONS

In 2015, Western participated in the CSCU Multi-Campus Hazard Mitigation Plan. The CSCU Multi-Campus Hazard Mitigation Plan provided recommendations surrounding energy resiliency that are also applicable for the Energy Master Plan. Recommendations from the hazard mitigation plan for improving the energy reliability and resiliency of the campus, include:

- Study and implement hardening of electrical feed on the Westside Campus from Middle River feed.
- Add a redundant fuel source on the Westside Campus (i.e., natural gas).
- Install an emergency generator to power the IT closets on campus to support VOIP.
- Add emergency generator capacity for essential systems (security, air handling, IT, repeaters, residence halls, etc.)
- Work with the utility to evaluate options for electrical service on the Westside Campus (isolate Westside Campus)
- Upgrade emergency generator on the West campus to enable distribution to digital systems.
- Evaluate and identify site for temporary boilers in case of emergency.
- Evaluate HVAC systems and upgrade vulnerable spaces (IT closets, computer labs).
- Retrofit and add insulation to select buildings to prevent burst pipes and other winter-related impacts.

CONCLUSION / NEXT STEPS

Western has focused on reducing energy use throughout the years, and securing significant savings with recommissioning programs, BMS upgrades and general energy management. Energy opportunities include lighting audits and upgrades, steam trap maintenance and building envelope upgrades. Challenges for the campuses include preventative maintenance and HVAC repairs, especially given budget recessions.

Top priorities for Western include:

- *Investigation of fuel switching:* Based on projected future fuel oil and gas prices and preliminary findings, it is likely in Western's best interest to consider switching the Westside campus heating fuel from oil to gas. This change could help decrease carbon emissions and save on operating and energy costs, to devote the additional savings to other imperative energy projects.
- *Management:* Review existing energy data on a more frequent basis, with an eye for outliers and energy intensive buildings by month. If resources are not available for an existing staff member to continuously monitor data, investigate opportunities for external support. Facilities should be routinely apprised of total energy spending.
- *Alternative Energy:* Investigate if Western is receiving RECs, and if not follow up with the fuel cell operator to ensure RECs are being generated. Western may consider monitoring incentives related to wind turbines, and a further study on wind potential on the Westside campus.
- *Renewable Energy:* Explore PPAs for rooftop solar, and bundle multiple solar sites.
- *Utility Incentives/ Develop Plan for EEMs:* Western should maximize incentive funding for EEMs by working with Eversource, and combining multiple energy saving opportunities in what is known as a "Comprehensive Project." Further analysis and collaboration with Eversource is required to determine rebate amounts for each opportunity.

A summary of further projects and priorities for the campus are listed in Table 2.8. Western has the opportunity to further optimize systems, save on energy spending and increase energy reliability and sustainability.

4.1 CONTACT INFORMATION FOR KEY STAKEHOLDERS

Collecting all the necessary information for this planning effort required a collaborative effort. Below are the stakeholders that were active in providing their expertise about campus current conditions and future needs, and energy related decisions.

WESTERN CONNECTICUT STATE UNIVERSITY

LUIGI MARCONE
Associate VP for Facilities
marconel@wscu.edu
203-837-9314

EVERSOURCE

JAMES WILLIAMSON
Energy Efficiency Consultant
james.williamson@eversource.com
860-665-2283

APPENDIX A: WESTERN DATA, METHODOLOGY, ASSUMPTIONS AND NOTES

The following are the data, methodology and assumptions that were used when analyzing and benchmarking data for Western:

- There is no information to indicate that the campus uses purchased chilled water or steam

Electricity: Utility Direct (FY13,14,15), Fuel Cell Estimated Generation

- Western indicated the Old Main Administration Building shares its account with 8 other buildings, the specific buildings were not identified.
- The campus EUI will increase if these buildings do not share accounts with existing buildings.

    1. Berkshire Hall
    2 Boiler Plant
    3. Higgins Hall
    4. Ives Concert Hall
    5. Litchfield Hall
    6. Midtown Student Center
    7. Newbury Hall
    8. Warner Hall
    9. Western Athletic Complex
    10. White Hall

- Multiple accounts in Utility Direct were excluded from the EUI calculations such as street lights and buildings that were not a part of the study.
- Fuel cell output was estimated to be 3,000,000 kWh/year based on fuel cell size and electrical efficiency.
- The Western Athletic Complex did not have an associated fuel account or consumption available, and is also not on the steam loop.

Natural Gas: Utility Direct (FY13,14,15)

- BTU submetering was not available for the Midtown Campus steam loop. Building-level EUIs cannot be calculated for any buildings in the Midtown campus at this time.
- Westside campus has oil only.

Propane: Utility Direct (FY15)

- The campus level site EUI cannot be calculated correctly with FY14 data missing.

Fuel Oil: Utility Direct (FY13,14,15)

General Assumptions

- Assumed that the building called Ives Concert Hall was neither the performance space within White Hall, nor the Concert Park, which the campus leases to the town. It is likely the storage shed or a Gazeebo near the Concert Park based on its GSF. Its exact consumption is unknown.

APPENDIX B: WESTERN CONNECTICUT STATE UNIVERSITY (WESTERN) CHP SCREENING

INTRODUCTION

The intent of this assessment is to provide a high-level review of Western Connecticut State University (Western)'s Boiler House and the potential for a cogeneration/combined heat and power (CHP) application on campus. The resulting conclusions are based on data review and discussion with campus plant personnel. The Boiler House on the Midtown Campus is being examined as the potential location for cogeneration. The Westside Campus is not being considered for siting CHP due to there being no natural gas service at that campus. The Midtown Campus already employs a form of cogeneration with its existing 400 kW fuel cell located at the Science Building. The Midtown Boiler House would serve as the potential location for a CHP at the end of the existing fuel cell's useful life.

EXISTING INFRASTRUCTURE

The Midtown Campus Boiler House includes two dual fuel 500 HP boilers installed around 2013 and an older Bigelow boiler as backup. The boilers are connected to an 80 to 100 psi steam distribution loop which supplies the Midtown Campus buildings with steam for heating. The domestic hot water system is a stand-alone loop. All underground piping is direct burial.

Thermal: Western's dual fuel boilers are used to provide steam through a distribution loop to several of the Midtown Campus buildings. The Science Building, originally supplied by the Boiler House, has a 400 kW fuel cell, which now provides a majority of the thermal energy needed by the building.

The Midtown Campus is on an interruptible natural gas contract and occasionally needs to switch to oil. The Westside campus currently does not have access to natural gas and would not support CHP at this time.

Electrical: Through an inventory of Western's electric accounts, 19 electric meters were accounted for, with the top five consuming approximately 72% of the total electrical energy use. Excluding the Science Building, the remaining top five accounts contribute to about 63% of the total.

The "Old Main Administration Building" meter is the largest electrical consumer at over 5,000,000 kWh and includes several buildings on the Midtown campus. The next largest electrical consumers are the Westside Classroom Building, O'Neill Center Field House, and Pinney Hall which are on the Westside campus. Even though these accounts are on the Westside campus, it is anticipated these accounts can be included through virtual net metering, explained later in this screening.

EXISTING CONSUMPTION

Evaluated Datasets: Utility:

Direct energy use reports for fiscal year (FY) 2014 and 2015 were used for this screening, including:

- Boiler House Natural Gas and Fuel Oil consumption monthly totals
- Electrical consumption monthly totals for each service at the Midtown and Westside campus

Based on the average of FY 2014 and 2015 natural gas consumption, the base thermal load during summer months, was found to be substantially less than during the colder months of the year. This trend is depicted in Figure A.

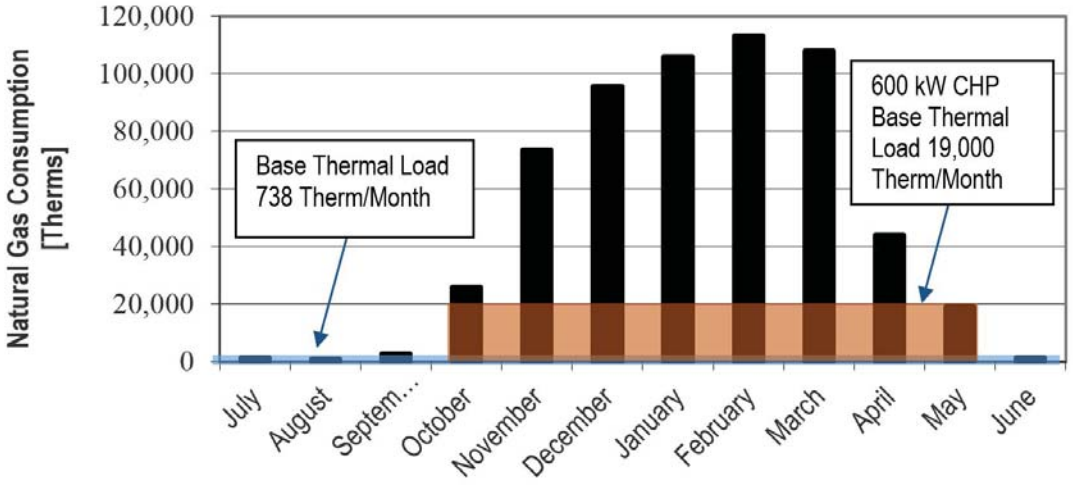

FIGURE A: Midtown Boiler House Thermal Load Profile

The base thermal load is indicative of the size CHP unit that would be best suited for the campus in order to maximize run time and efficiency. A simple hourly average of the base thermal load in the summer months would not support cogeneration while the thermal load from October through May could. The minimum hourly simple average for October through May is approximately 25 therms per hour.

OPPORTUNITY, CONCLUSIONS AND NEXT STEPS

The existing infrastructure at Western could potentially support a 600 kW CHP installation for part of the year. CHP systems are classified as a Class III alternative energy in Connecticut and are therefore eligible for virtual net metering, given that they meet a minimum 50% overall efficiency. Virtual net metering would allow up to five electrical services to benefit from the excess generation on one service. In theory, excess generation at the Midtown campus could offset use at the Westside even though they are not physically connected. The utility would need to be consulted to confirm eligibility and specifics. Virtual net-metering with up to five accounts and an existing steam loop at the Midtown campus would allow the CHP to run at design load eight months of the year. An additional absorption chiller and distribution would need to be added to support the CHP through the remainder of the year.

The Potential Utilities Report attached shows how a 600 kW internal combustion CHP would provide a baseload of thermal energy from May through October. The report also demonstrates the estimated effect of a 600 kW CHP on the Boiler House's natural gas consumption and its top five electric meters. The top five electric meters are used assuming virtual net metering is implemented, since the single largest meter would not have a high enough electrical demand to support 100% generation behind the meter.

Assuming a CHP system installation cost at $3,250 per kW, electrical energy rate of $0.1304 per kWh, and natural gas energy rate of $0.984 per MMBtu, a simple payback near 7.2 years could be expected before incentives with no additional infrastructure upgrades and where the CHP only operated eight months of the year.

The thermal and electric loads at Western indicate a moderate CHP potential for additional cogeneration. However, the effectiveness of the system without the need for heat year round reduces the efficiency of the system if oversized beyond the minimum thermal load. Thermally driven (absorption) chillers can increase the summer heat load, but without a chiller loop on campus this is an unlikely scenario. It is recommended that electrical and thermal data continue to be collected for future cogeneration analysis. New onsite generation should be evaluated at the end of the existing 400kW fuel cell's cost effective life.