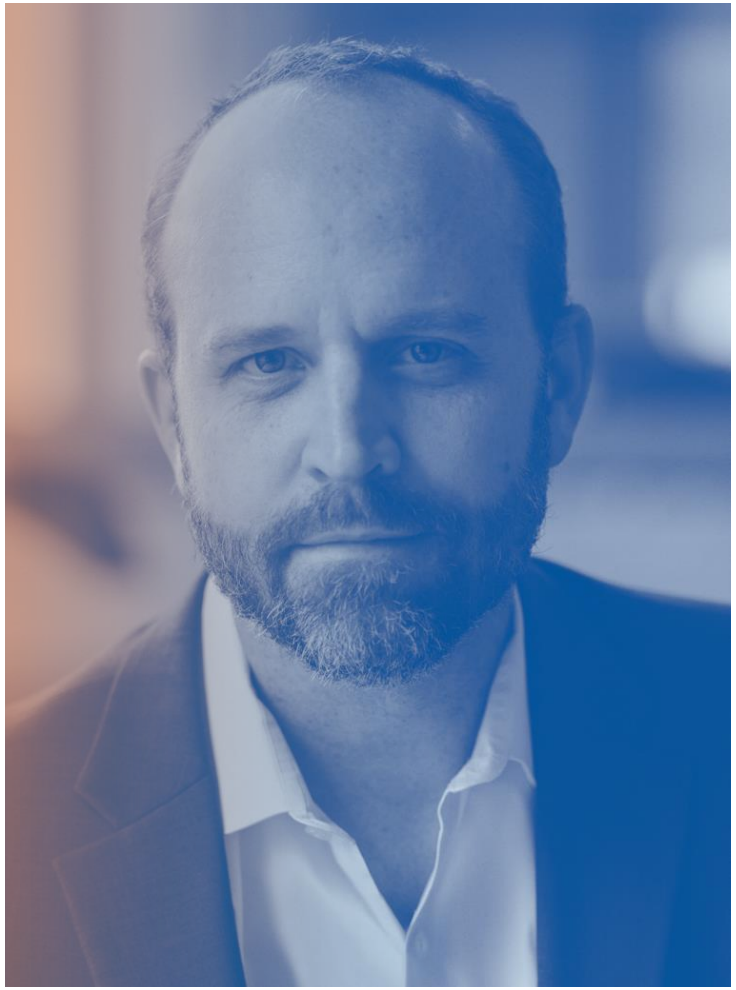
SCUP PRESENTATION

RESETTING THE CLOCK

A FACILITY RENEWAL & PROGRAM ENHANCEMENT PLAN FOR DUKE'S NEXT 100 YEARS

ADEM GUSA
Director of Planning & Design
Duke University



ROB VOSS
Principal
Ballinger

DENNIS POTTER
Principal
Ballinger

ITEM ONE

DUKE’S NEEDS / SETTING THE SCENE

ITEM TWO

FINDINGS & RENEWAL STRATEGIES

ITEM THREE

ENGINEERING / SUSTAINABILITY RECOMMENDATIONS

ITEM FOUR

SUMMARY & NEXT STEPS

PRESENTATION OVERVIEW

LEARNING OUTCOMES

1

Determine the starting point by prioritizing aging campus buildings based on qualitative and quantitative criteria.

2

Embrace and re-envision creative strategies for renewal and modernization of historically sensitive buildings to position them for the next 100 years.

3

Empower diverse stakeholders to understand their role in supporting future-flexible building projects.

4

Develop implementation strategies that maximize time and minimize disruption.

ITEM ONE

DUKE’S NEEDS / SETTING THE SCENE

BY THE NUMBERS

DUKE UNIVERSITY

Located in Durham, NC

Founded in 1924

21M GSF on Campus
in just over 300 Buildings
(including Hospital)

1,200 acres on Main Campus (with an Additional 7,000 Acres of Duke Forest)

6,400 Undergraduates

14,400 Graduate and Professional Students

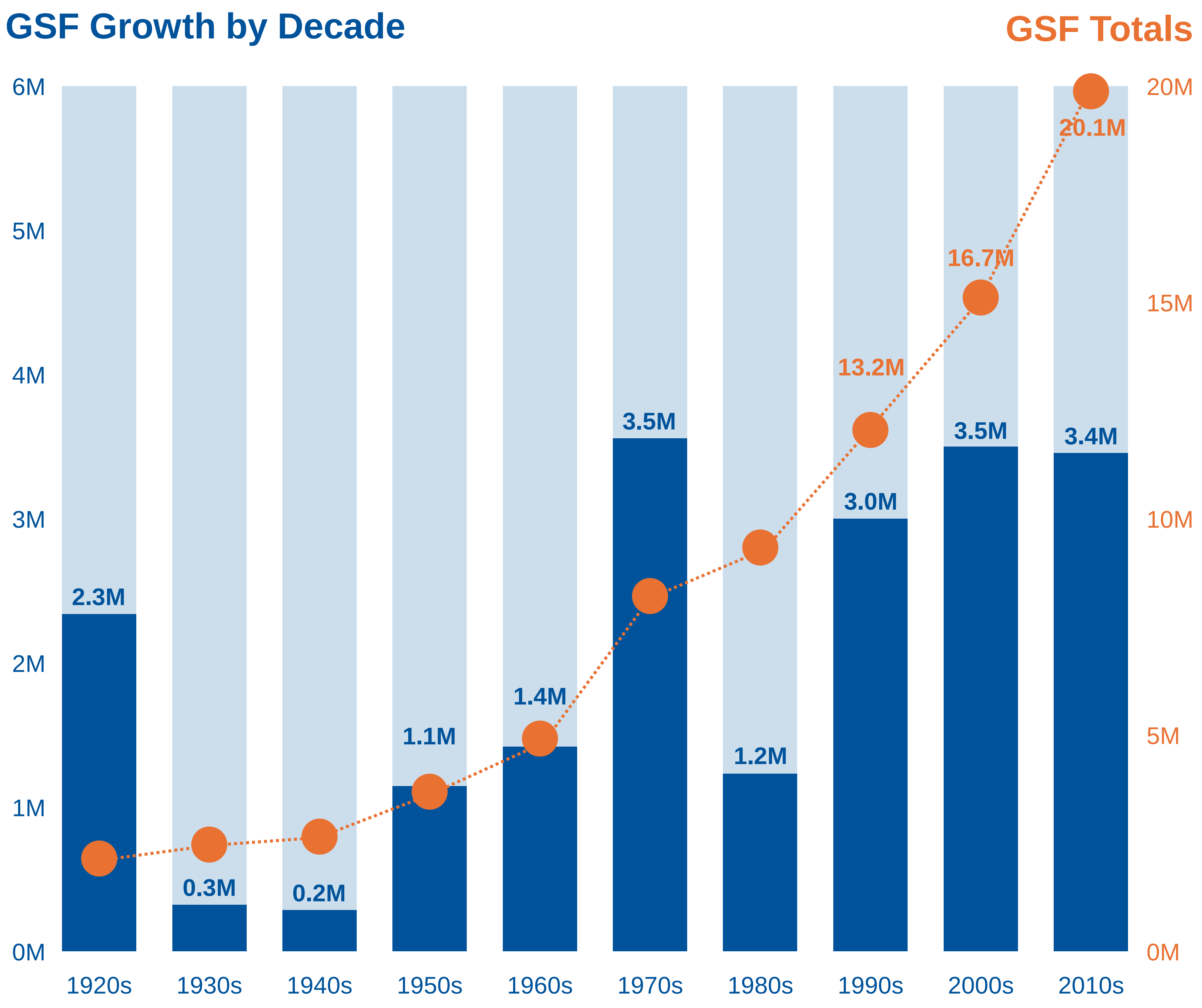
HISTORY OF FACILITIES GROWTH

DUKE TOTAL GSF GROWTH BY DECADE

On average Duke has grown over 340,000 GSF per year for the past 20 years.

This level of growth is not sustainable.

Pandemic allowed us to pump breaks on growth and prioritize being better stewards of what we already have.



OVERVIEW OF FACILITY RENEWAL

BUILDINGS

- 16.3M gross square feet
- 255 buildings
- Campus classroom, office, laboratory, athletic, libraries, residence halls, dining, and parking garages
- SoM/N lab, office, classroom
- Excludes hospital/clinic and hotel buildings and leased properties

UTILITIES

- Chilled Water Plants
- Hot Water & Steam Plants
- Electrical Substations
- Water/Sewer/Storm Piping
- 200 miles of distribution

LANDSCAPE

- 1,300 acre campus^
- 380 acres maintained^^
- 17,000 trees maintained
- 13 athletic fields

HARDSCAPE

- 13 miles of roads
- 44 miles of sidewalks
- 100 acres of parking lots
- 21 bridges
- 5 miles of trails

OVERVIEW OF FACILITY RENEWAL

METHODOLOGY TO ASSESS & PRIORITIZE

Net Asset Value (NAV)

Facility Mission Criticality

Current Condition/Lived-In Experience

Interdependencies of Buildings and Programs

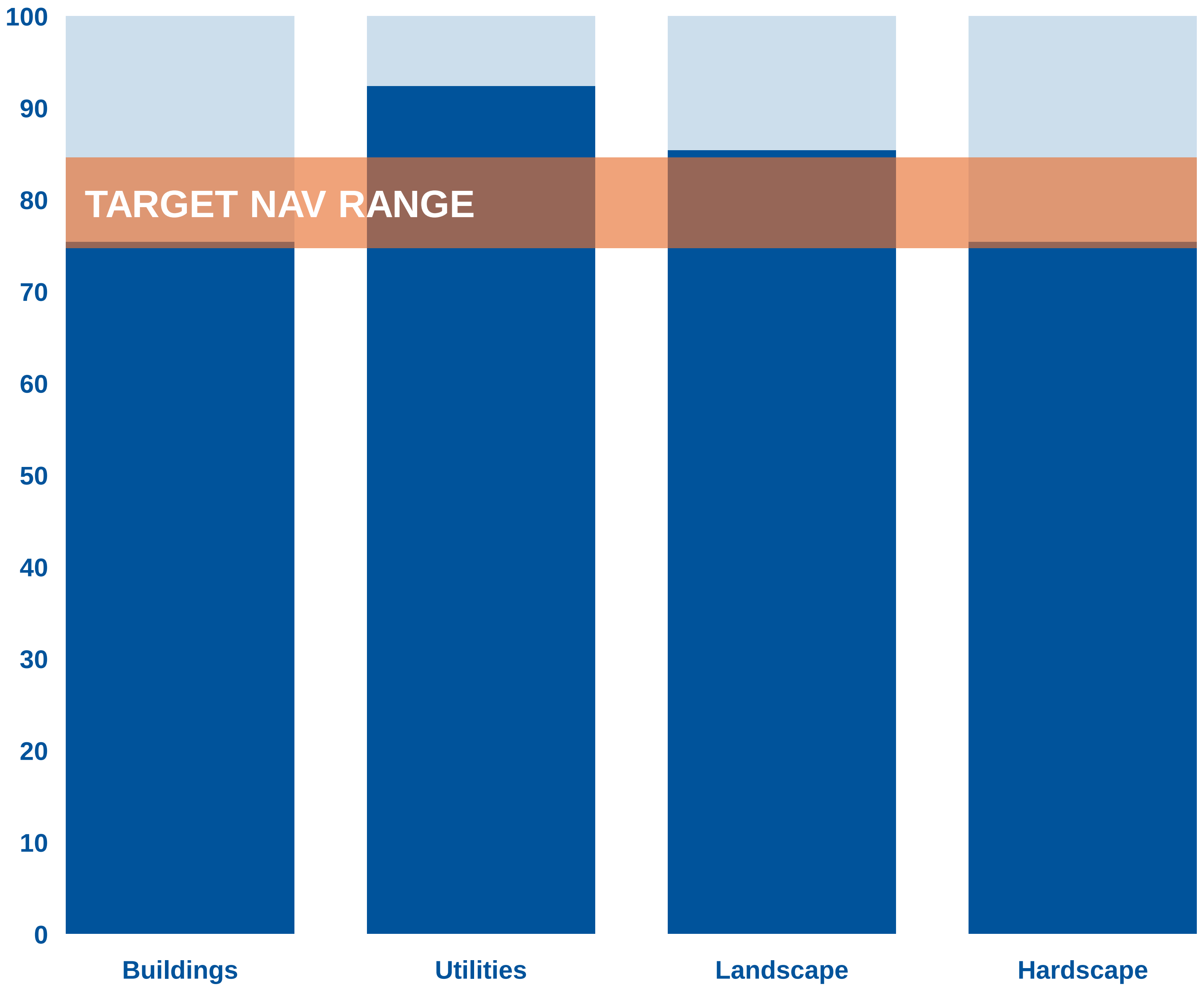
NAV Index

100-85%	CAPITAL UPKEEP
70-85%	REPAIR & MAINTAIN
<70%	SYSTEMIC RENOVATION

OVERVIEW OF FACILITY RENEWAL

CONDITION OF DUKE PORTFOLIOS

The Building portfolio has the lowest overall condition of all portfolios, below the target NAV range of 75% - 85%

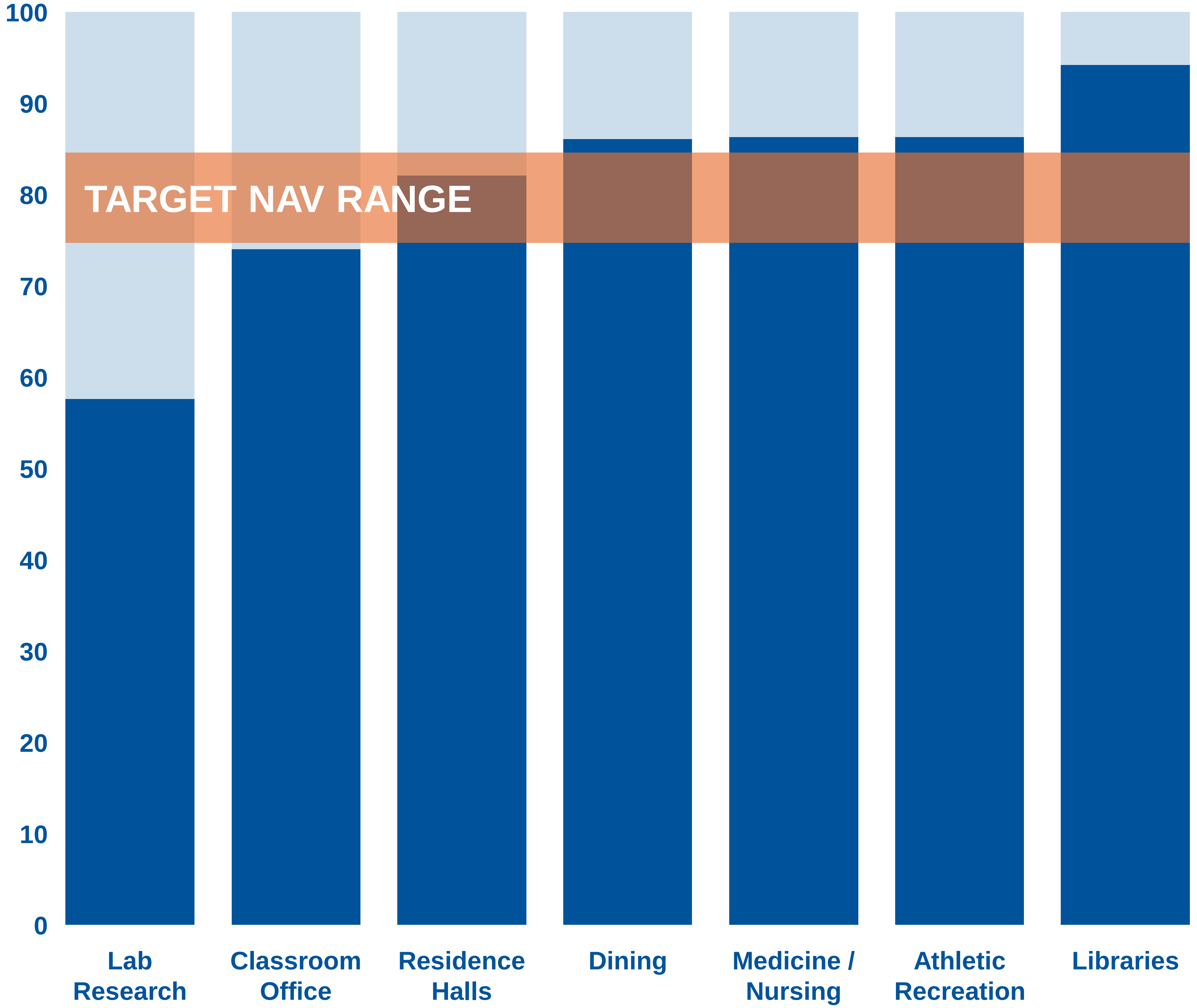


OVERVIEW OF FACILITY RENEWAL

BUILDING CONDITION BY TYPE

Types of facilities within the buildings category (e.g., Libraries) with higher NAVs reflect recent investments in renewal and new facilities.

Campus lab/research and classroom/office building types are, as a class, the lowest NAVs on campus.

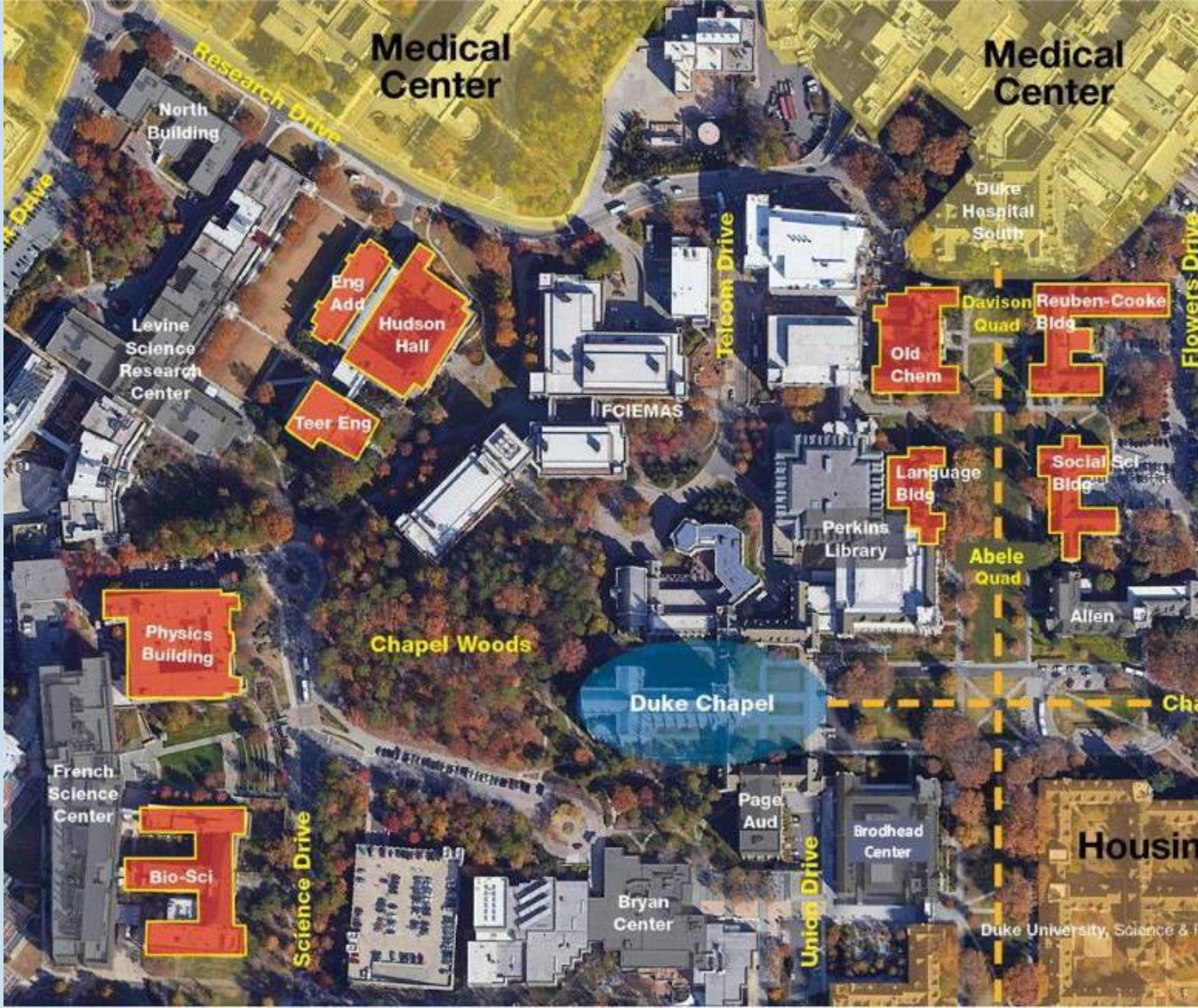


FACILITIES RENEWAL PLANNING STUDY

KEY FOCUS IN THE BUILDING PORTFOLIO

When you factor in qualitative and quantitative factors, nine buildings with NAVs below 60%, emerged as highest priority.

This study focused on a select group of critical Trinity and Pratt research and teaching facilities as shown in red in the adjacent graphic.

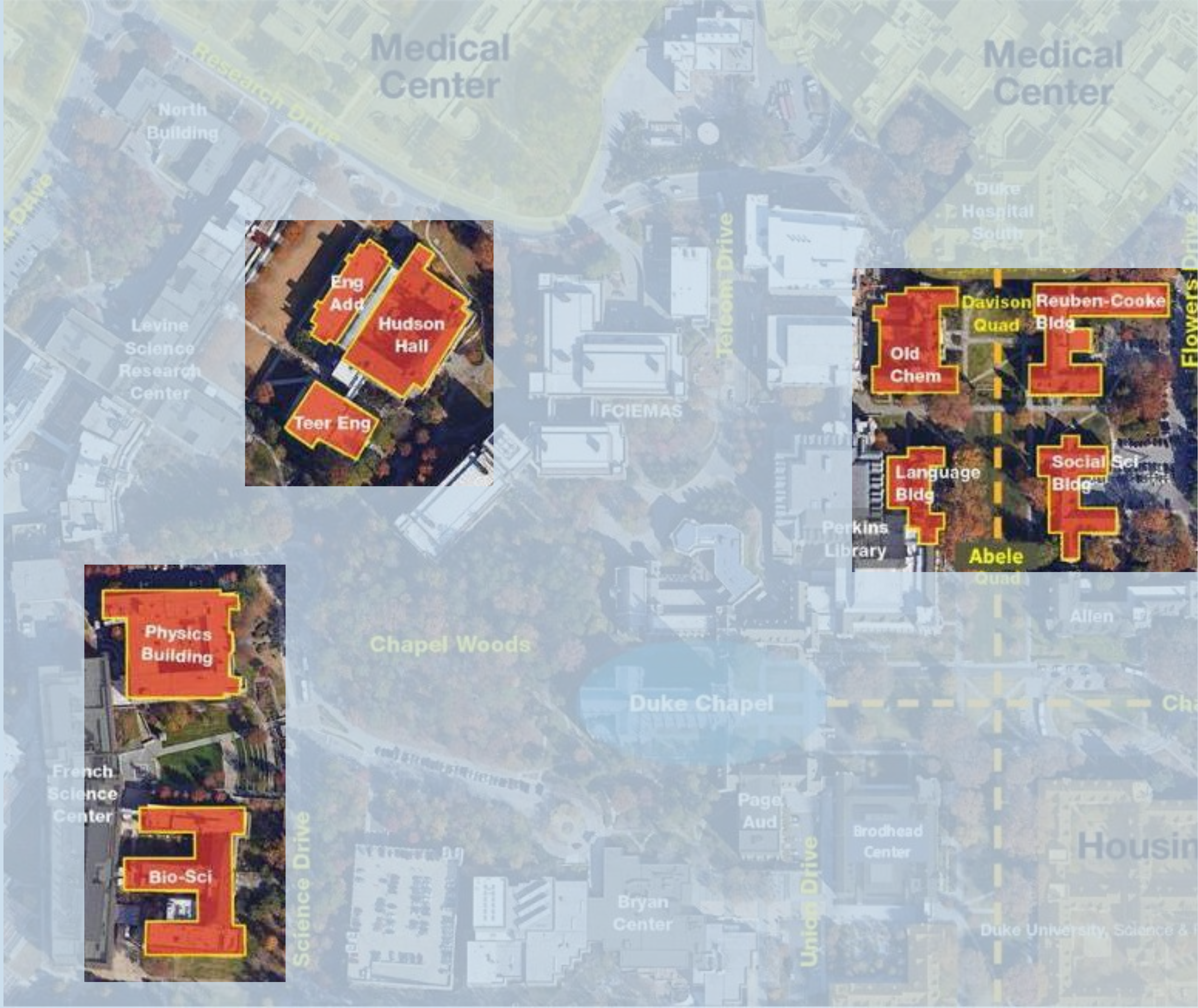


FACILITIES RENEWAL PLANNING STUDY

KEY FOCUS IN THE BUILDING PORTFOLIO

The buildings in this study represent approximately 690,000 GSF and contain over 20 different departments.

A holistic approach was necessary to develop a comprehensive and long-range renewal plan.

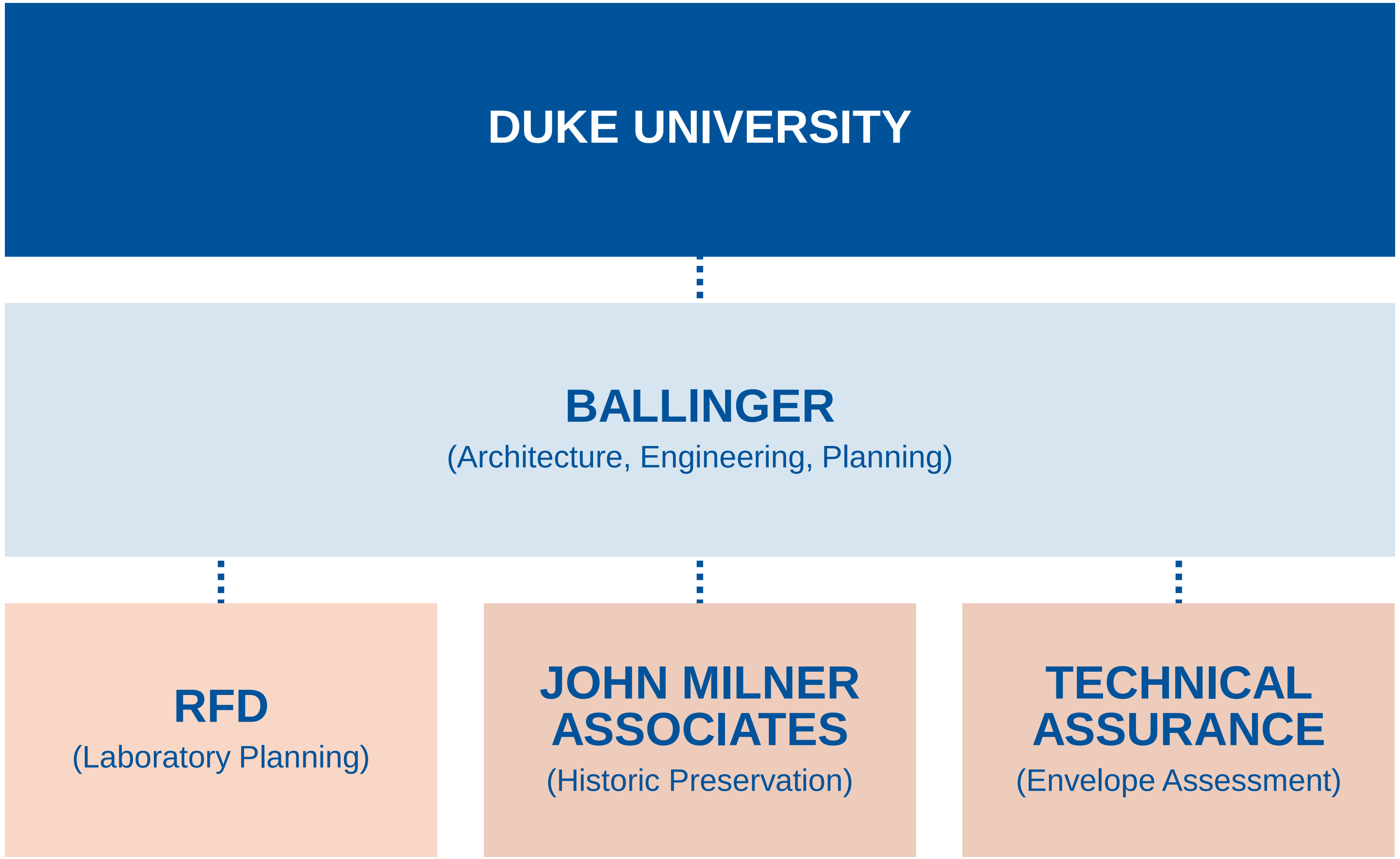


ITEM TWO

FINDINGS & RENEWAL STRATEGIES

PROJECT WORKPLAN

RENEWAL TEAM



PROJECT WORKPLAN

OVERLAPPING TRACKS

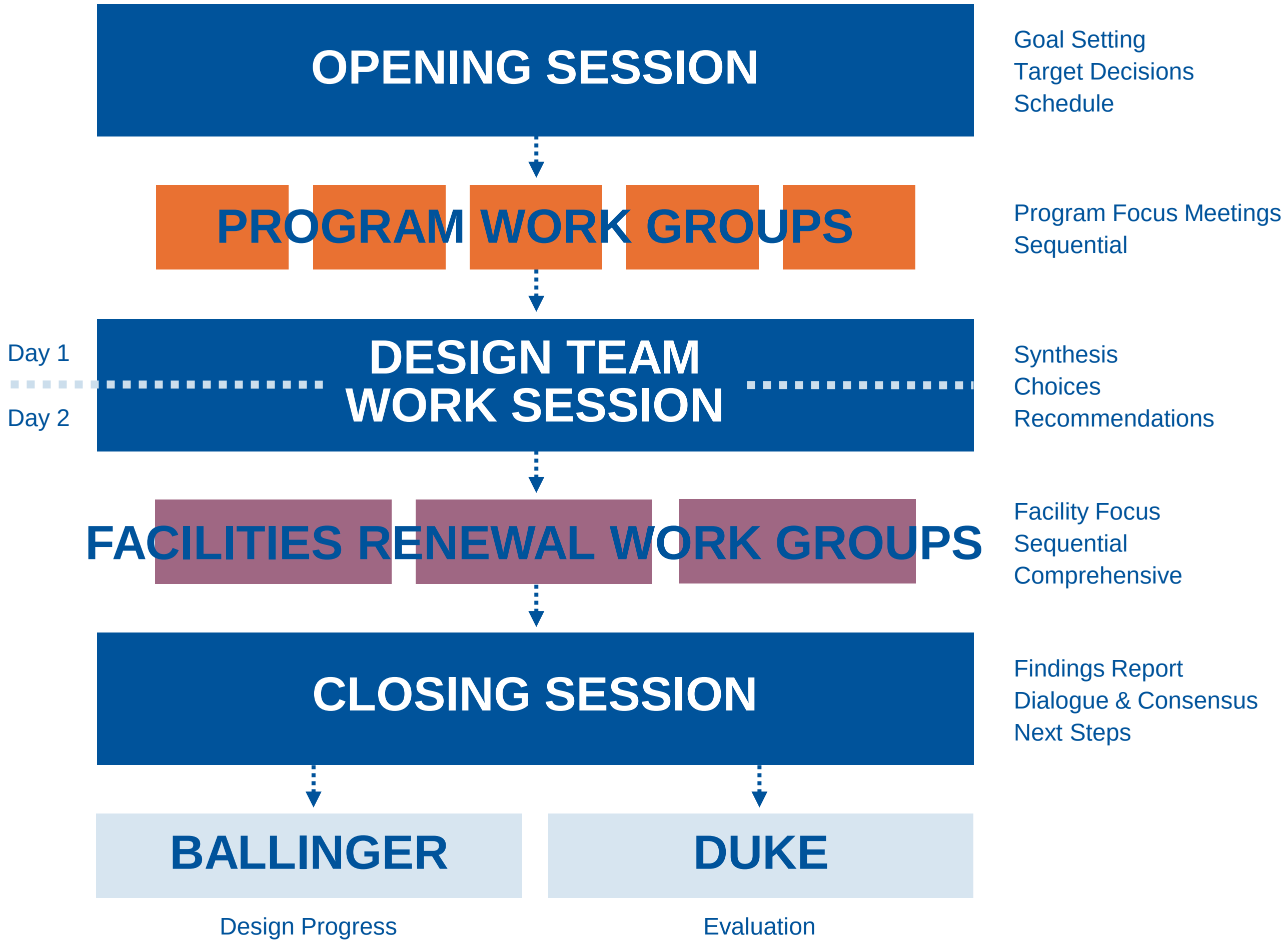
Virtual Management Meeting (between each stage)

Track	Prep August	Duke Core Team September On-Campus	Duke Core Team October On-Campus	Duke Core Team November On-Campus	Duke Core Team December On-Campus	Duke Core Team January On-Campus	Duke Core Team February On-Campus	Final Presentation On-Campus
PROGRAMMING Trinity College of Arts & Sciences Pratt School of Engineering Programming Team Leadership	**Collect Data** Research Lab Teaching Lab Classrooms Personnel Utilization Data	**Program Vision** Trinity College of Arts & Sciences Pratt College of Engineering	**Program Draft** **Vision of the Future**	Develop Concept Options	**Final Program** **Goal for Renewal**			**VISION FOR THE FUTURE** **Final Program** **Facility Renewal Plan** **Systems Strategy** **Phasing Sequence** **Milestone Schedule** **Long Range Costs**
FACILITY RENEWAL Duke Facilities Management Planning Strategy Design Leadership Engineering Systems & Infrastructure	**Collect Data** Facility Plans Feasibility Studies Tableau Access Energy Use Data Life Cycle Info	**Observe & Tour** Assess Existing Facilities Campus Context Influence	**Review Current Facility Baseline** Quality, Capacity Suitability	**Overview Facility Findings** **Determine Concept Options**	**Review Concept Options** **Select Preferred Strategy**	**Further Refine Strategy** **Finalize Systems Impact**	**Determine Final Renewal Strategy**	
IMPLEMENTATION Duke Real Estate Development & Financial Services Construction Management Team	**Collect Data** Swing Space Data Utility Plans Previous Studies				**Swing Space**	**Evaluate** Sequence Phasing Timeline	**Evaluate** Costs Phasing Feasibility	
	LEADERSHIP INTERVIEW	Workshop 1 Q3 - 2022	Workshop 2 Q4 - 2022	Workshop 3 Q4 - 2022	Workshop 4 Q4 - 2022	Workshop 5 Q1 - 2023	Workshop 6 Q1 - 2023	

FACILITIES RENEWAL

ENGAGEMENT

WORKSHOP PROCESS



KICK-OFF

INTERVIEW SUMMARIES

22 Stakeholders

Over **5** Days

30-60 minutes each

OUTCOMES & OPPORTUNITIES

- Suggest a sequence that makes sense programmatically and physically, not initially bound by cost per year
- Big picture assessment is required to move forward
- Support Duke's Science and Technology Initiative (DST)
  - *Artificial Intelligence Computer Science*
  - *Materials*
  - *Resilience – Biological Resilience*
- Allow for programs to think outside of their current physical limitations
- Upgrade buildings to create great spaces for research - Engender collaboration

CONCERNS

- Discipline to stay focused on the end game – RENEWAL
- Swing space needs for bio-sci, physics and engineering – Concern project will need more swing space than available
- Managing expectations – realistic about cost, timeline, and dependencies along the way
- Too focused on renewal that we lose sight of program that will take Duke to the next level
- Arrive at answer that there is a percentage of research need that cannot be met by this renewal – don't want to start there - This is a renewal that is seeking innovation and creative solutions to support the needs

FACILITIES RENEWAL PROGRAM

PROJECT FOCUS

PROGRAM ENHANCEMENTS

Enhanced Research & Teaching Space

Flexible-Adaptable-Modern Space Conversions

IMPROVED CONDITION

Maximum

LEVELS OF RENEWAL

RENEWAL

Minimize Carbon Footprint

Investment in Existing Teams and Buildings

Develop Spatial Opportunities Through Implementation & Phasing

Minimum

EXISTING CONDITION

Modernize Systems (Support Modern Science, Teaching & Research)

Improved Envelope (Roof, Windows, Masonry)

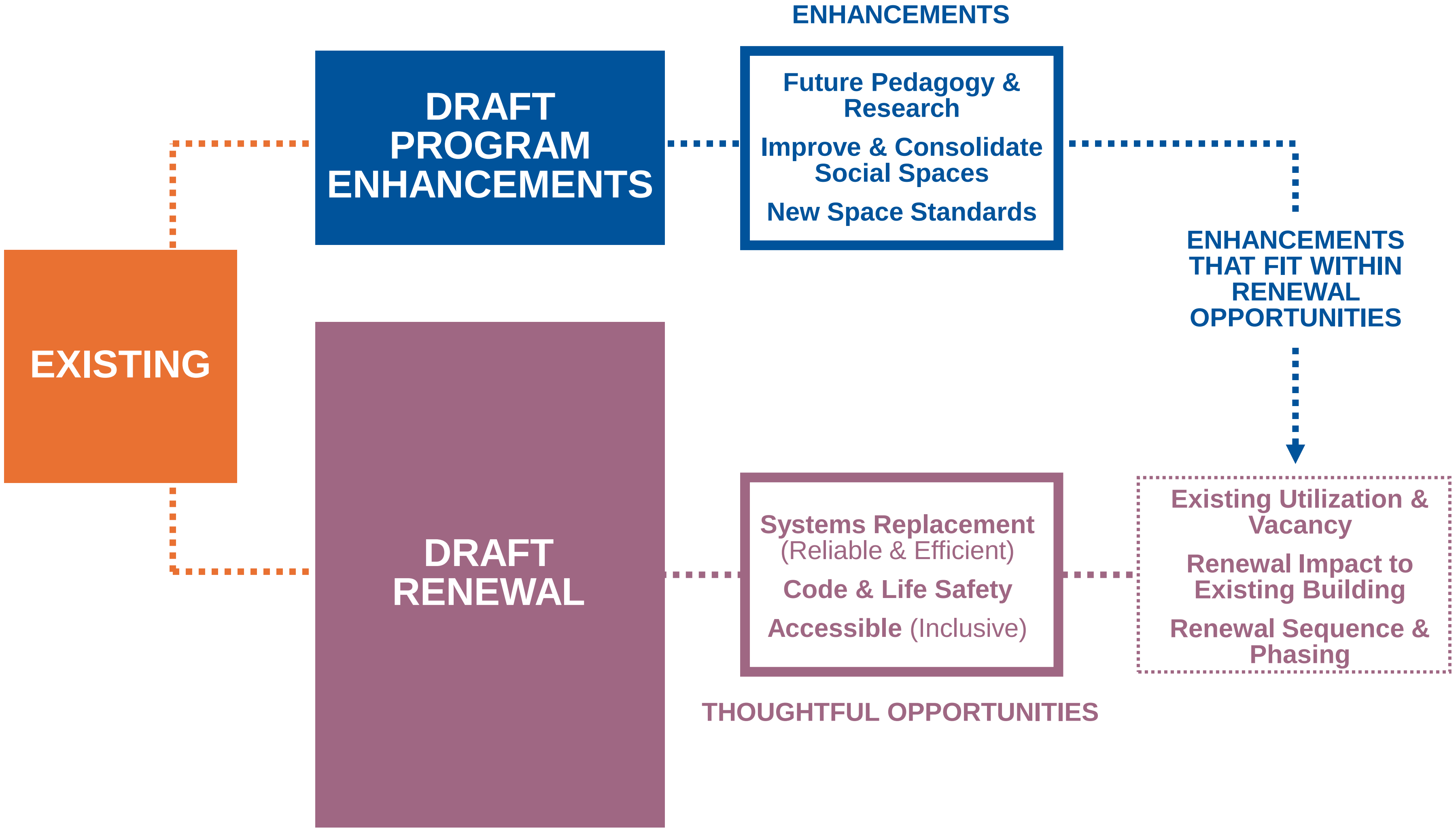
Internal Opportunities

Accessible (Toilet Rooms, Elevators, Entrances, Egress)

Current Code Compliance (Toilet Rooms, Life Safety, etc.)

FACILITIES RENEWAL PROGRAM

ROADMAP



FACILITIES RENEWAL PROGRAM

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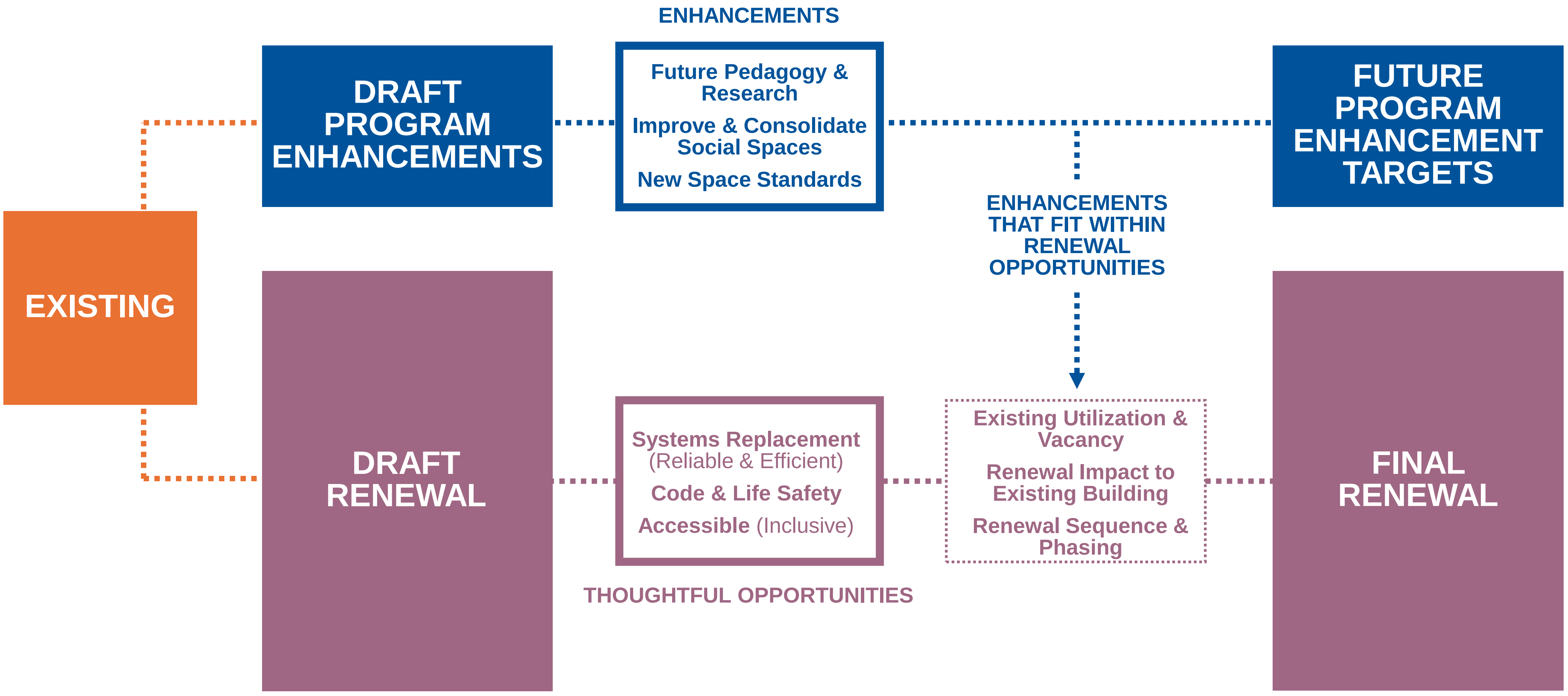

EVALUATION CRITERIA

HISTORIC SIGNIFICANCE

- Multiple Criteria Established by the **National Park Service**
- Representative of the History, Architecture, Archeology, Engineering, or Culture of an Era.

ENVELOPE + STRUCTURE

- **Existing Condition Assessment**
- Exterior Wall Assembly
- Existing Dew Point Analysis
- Structural System + Condition
- Structural Bay Size + Floor to Floor

PROGRAM SUITABILITY

- Existing Program
- **Duke Metrics**
- Future Focus
- Facility Fit

ENERGY AND CARBON

- Existing Conditions
- **Digital Twin Energy Model**
- Systems Options
- Energy + CO2 Reductions

9 BUILDINGS IN STUDY

HISTORIC SIGNIFICANCE

Representative of the history, architecture, archeology, engineering, or culture of an era.

Physics (1949)

Teer (1984)

Old Chem (1930)

Reuben-Cooke (1931)

Biological Sciences (1962)

Hudson (1948) + Annex (1973)

Languages (1929)

Social Sciences (1931)

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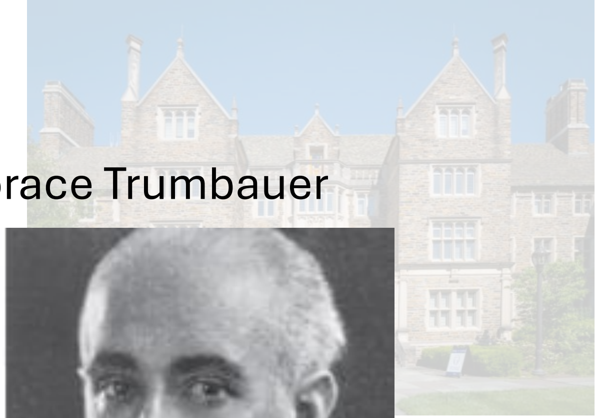
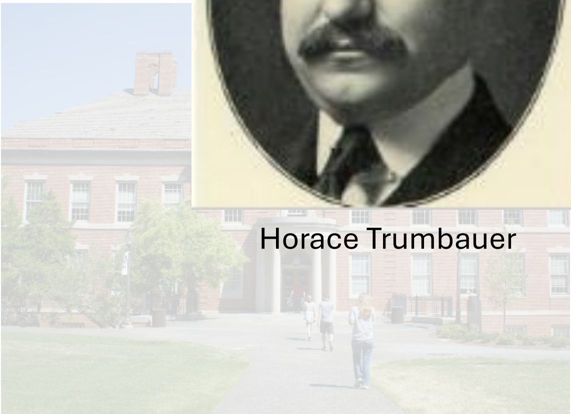
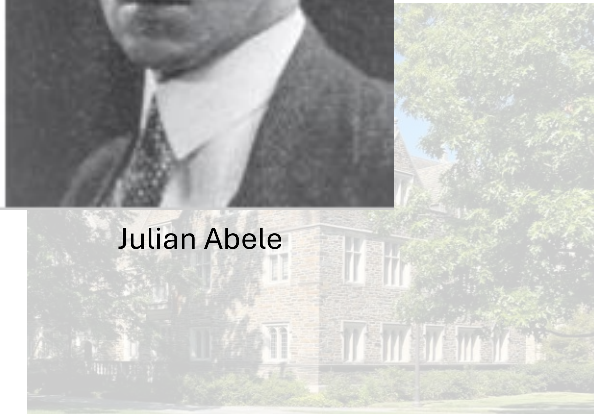


Reuben-Cooke (1931)

Biological Sciences (1962)



Hudson (1948) + Annex (1973)



Languages (1929)

Social Sciences (1931)

The Office of Horace Trumbauer

Horace Trumbauer

Julian Abele

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Low Priority

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"Red Bricks" – High to Medium Priority

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PROGRAM SUITABILITY

- Existing Program
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- Facility Fit

ENERGY AND CARBON

- Existing Conditions
- **Digital Twin Energy Model**
- Systems Options
- Energy + CO2 Reductions

COMPONENT OF EVALUATION

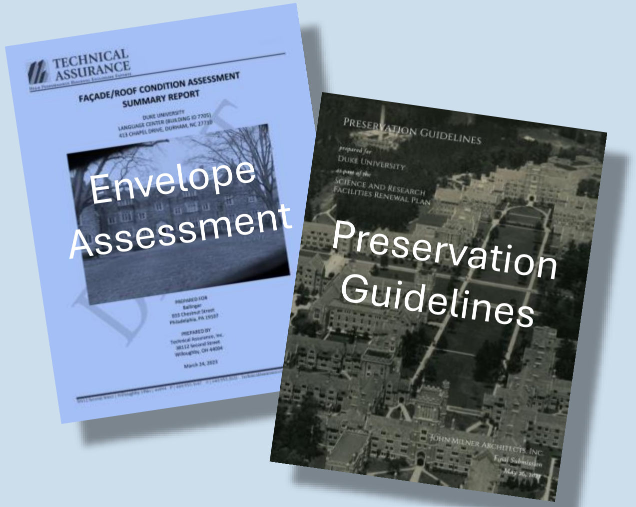
ENVELOPE + STRUCTURE

Evaluation Criteria

A. Façade Observations and Conditions
B. Dew Point Analysis
C. Roof Observations and Conditions
D. Structural System + Bay Spacing

Overall Recommendations:

Repair Duke Stone steel window systems
Replace “Red Brick’s” window systems
Replace sealant
Tuckpointing of brick and limestone
Painting exposed steel
Limited lintel replacement




Detail of paint buildup at typical outswing hinge and failing glazing putty.


Visible surface rust, failing perimeter sealant and broken pane.


Copper exterior lighting.


Interior stone surround with minor water staining.


Diamond leaded panel at Languages.


Louvered window replacement.


Stained wood doors and transoms.


Bay window configuration with ornate limestone tracery.


Damaged cames at Gothic arch transom.


Carved limestone.

EVALUATION CRITERIA

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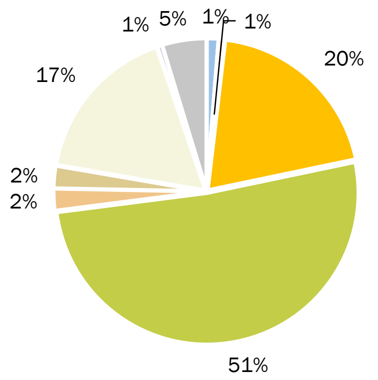
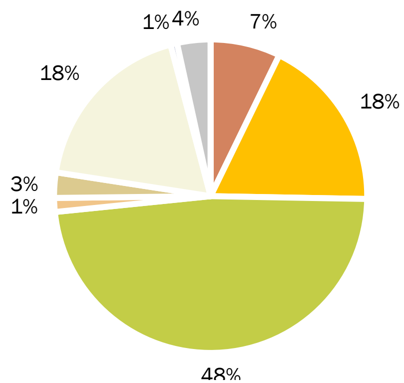
EXISTING PROGRAM

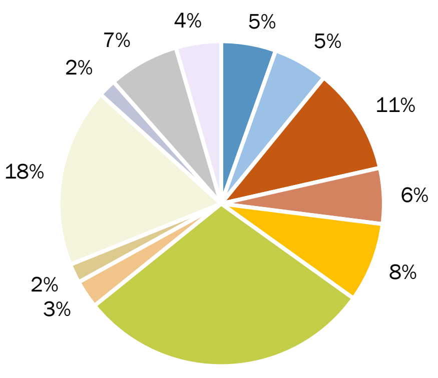
PROGRAM SUITABILITY



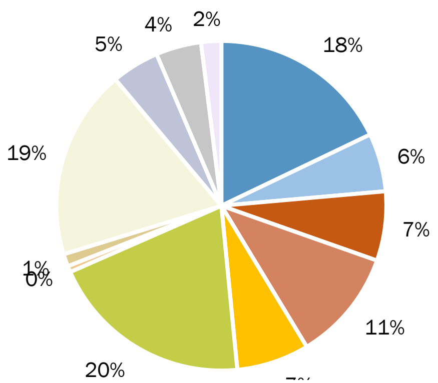
Social Sciences



Language Center



Physics



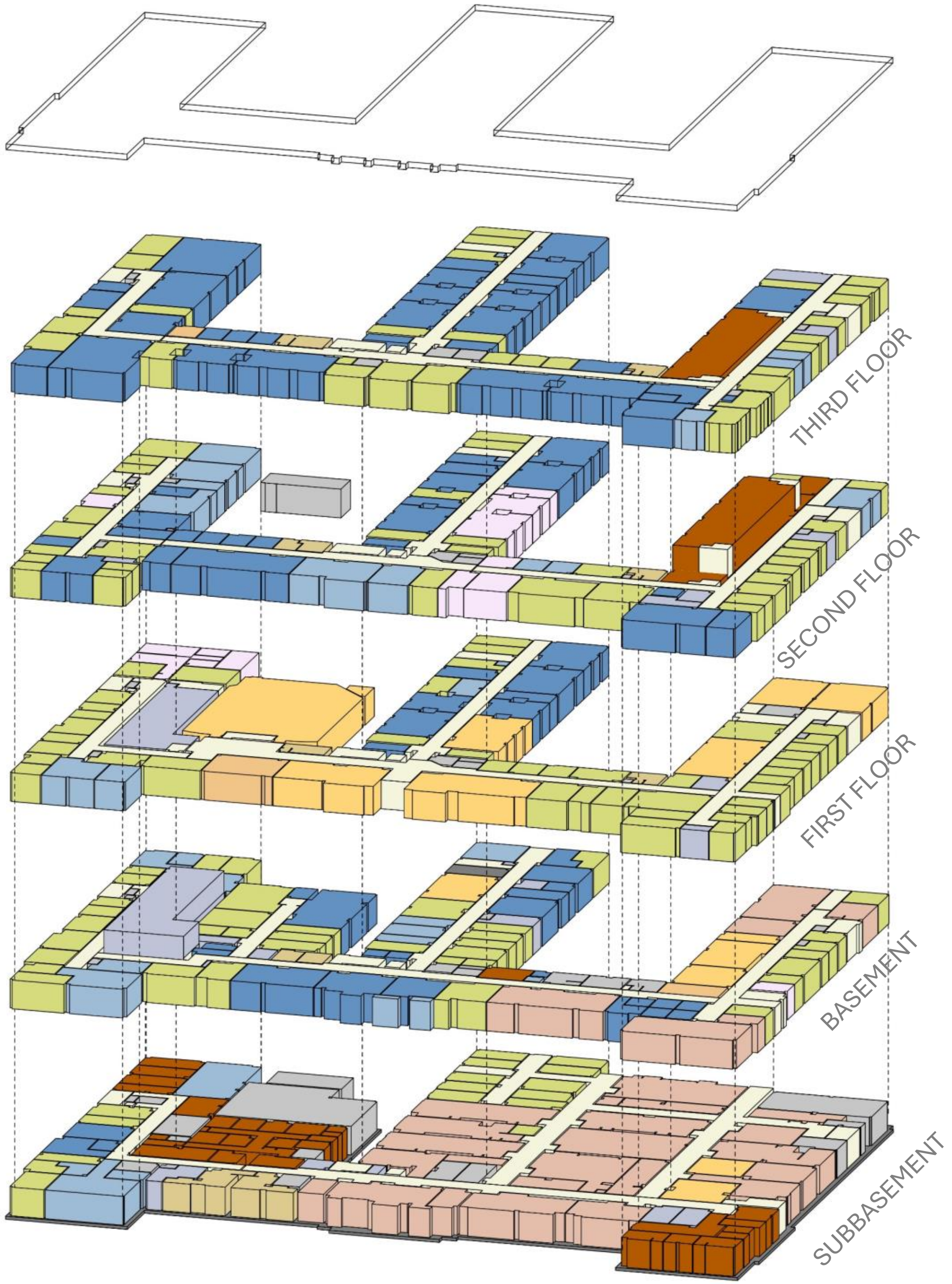
Biological Sciences

Program Type	Social Sciences Quantity	Social Sciences Existing NASF	Language Center Quantity	Language Center Existing NASF	Physics Quantity	Physics Existing NASF	Biological Sciences Quantity	Biological Sciences Existing NASF
Wet Lab Research	0	**0**	0	**0**	7 PIs	**5,937**	31 PI	**26,252**
Dry Lab Research	1	**532**	1	**532**	5 PIs	**5,937**	13 PI	**8,493**
Research Core	0	**0**	0	**0**	21	**11,544**	36	**9,984**
Class Lab	1	**255**	2	**1,521**	14	**6,056**	30	**16,068**
Classroom	12	**9,190**	11	**8,401**	11	**8,616**	15	**10,253**
Office +Workplace	128	**20,899**	129	**21,688**	163	**31,988**	157	**28,715**
Community	3	**995**	3	**995**	8	**3,033**	5	**1,642**
Toilet + Lactation	9	**1,012**	9	**1,012**	13	**2,083**	12	**1,790**
Circulation	26	**7,217**	26	**7,217**	51	**19,468**	67	**27,356**
Storage	5	**221**	5	**221**	8	**1,921**	24	**6,861**
Building Support + MEP	16	**1,995**	16	**1,995**	52	**7,663**	54	**6,848**
Vacant / Inactive/ Transitional	0	**0**	0	**0**	16	**4,901**	10	**2,625**
Total Program Area		**40,100**		**40,100**		**109,147**		**146,594**
Total Building Area		**54,154**		**54,154**		**122,556**		**166,601**

EXISTING PROGRAM

PROGRAM SUITABILITY

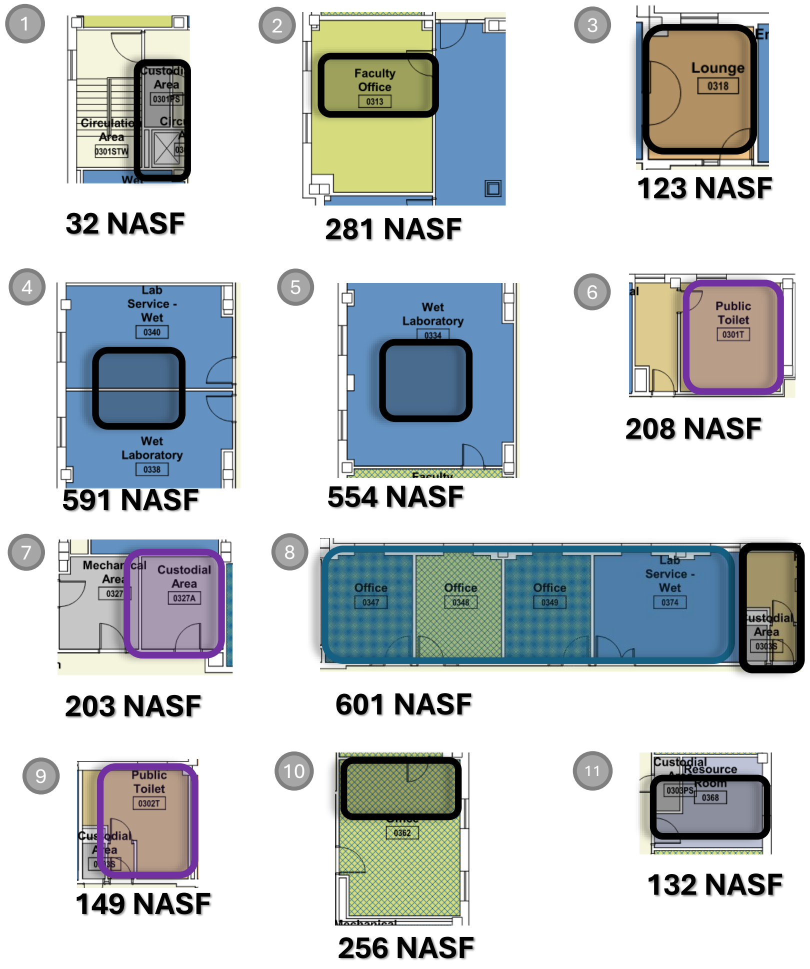
		Quantity	Existing NASF
	7758 Biological Sciences		
(Wet Lab Research color)	Wet Lab Research	31 PI	**26,252**
(Dry Lab Research color)	Dry Lab Research	13 PI	**8,493**
(Research Cores color)	Research Cores	36	**9,984**
(Class Lab color)	Class Lab	30	**16,068**
(Classroom color)	Classroom	15	**10,253**
(Office +Workplace color)	Office +Workplace	157	**28,715**
(Community color)	Community	5	**1,642**
(Vacant / Inactive/ Transitional color)	Vacant / Inactive/ Transitional	10	**2,625**
	Total Program Area		**104,032**
	Total Building Gross Area		**166,601**

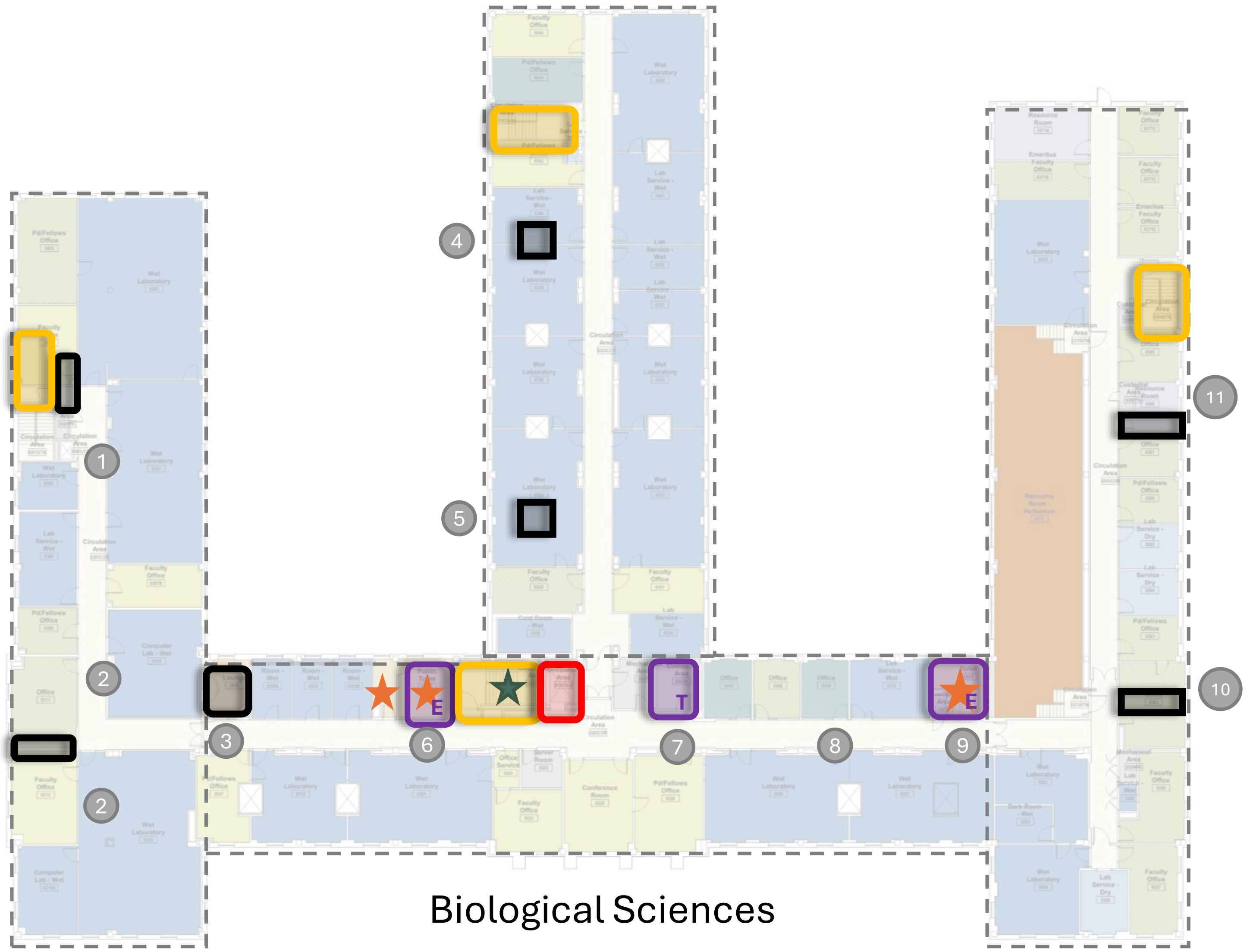


FACILITY FIT

PROGRAM SUITABILITY

IMPACTED PROGRAM **3,130 nasf**





EXISTING TOILET ROOM
PROPOSED TOILET ROOMS
ELEVATOR IMPROVEMENTS
PROPOSED MECH SHAFTS
STAIR AND RAMP IMPROVEMENTS
PROPOSED TELECOM/ELECTRICAL ROOMS

FUTURE FOCUS

PROGRAM SUITABILITY

WET ⟷ DRY

EXPERIMENTAL BIOLOGY
CHEMISTRY
ENGINEERING SCIENCES
PHYSICAL SCIENCES

- 100% Outside Air
- Ventilation Density: 6-12 ACH
- Temp./Humidity Controls: Lab Grade
- Chemicals / Gases / Etc? : Yes
- Workstation Location: Outside Lab

ELECTRONICS
PHYSICS

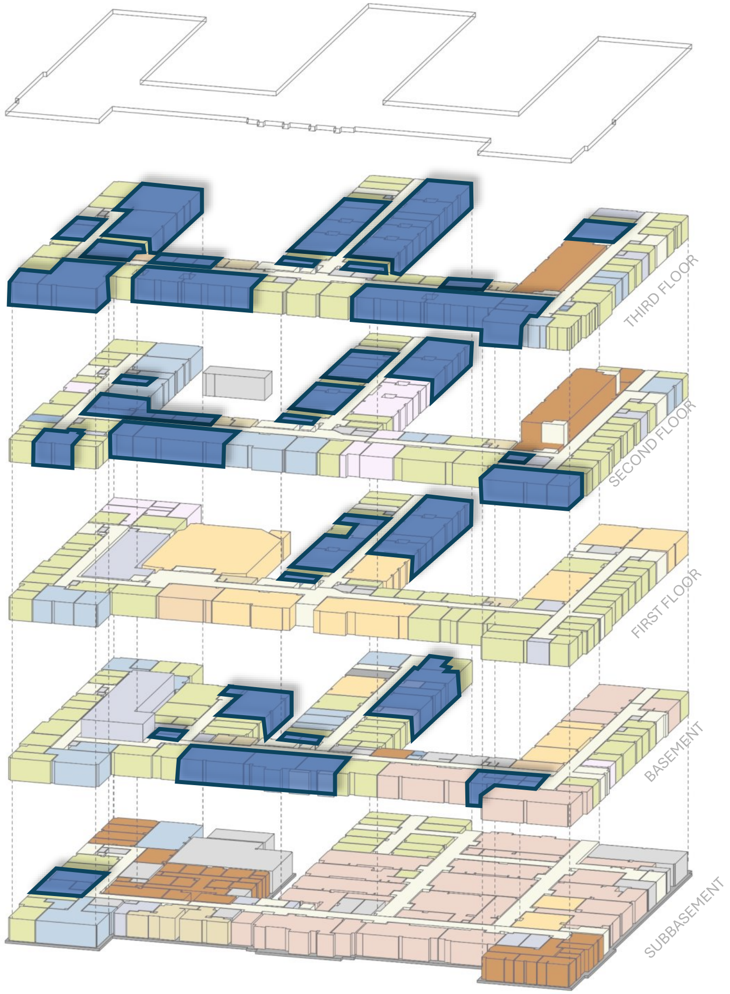
- Recirculated Air
- Ventilation Density: 4-8 ACH
- Temp./Humidity Controls: Lab Grade
- Chemicals / Gases / Etc? : Limited
- Workstation Location: Inside Lab

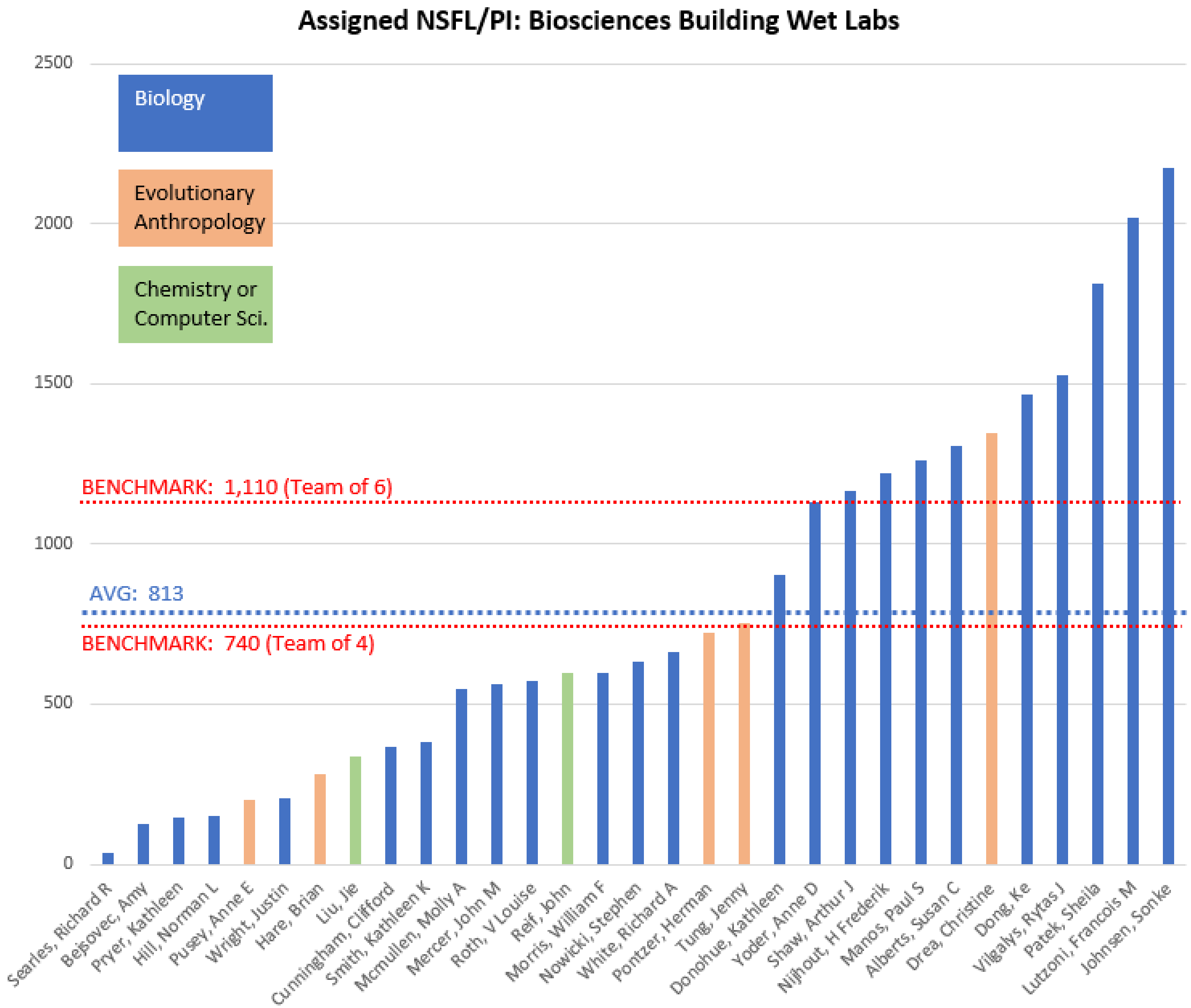
THEORETICAL
COMPUTATIONAL

- Recirculated Air
- Ventilation Density: 2-6 ACH
- Temp./Humidity Controls: Office Grade
- Chemicals / Gases / Etc? : No
- Workstation Location: Inside Lab

DUKE METRICS

PROGRAM SUITABILITY

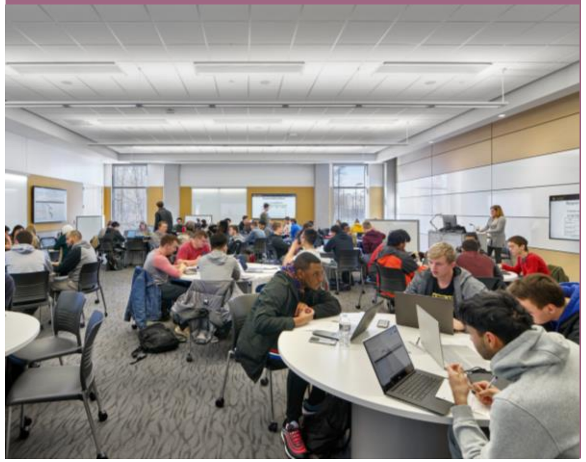
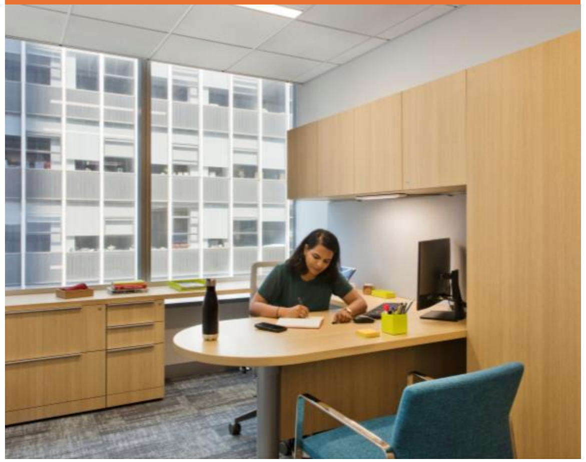
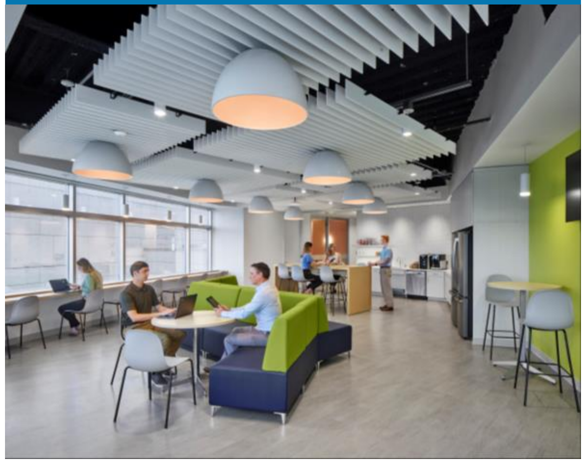




DUKE METRICS

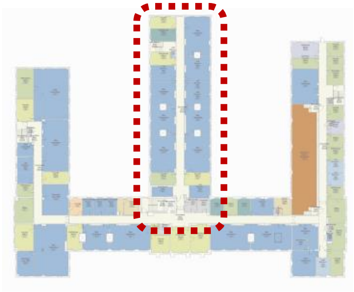
PROGRAM SUITABILITY

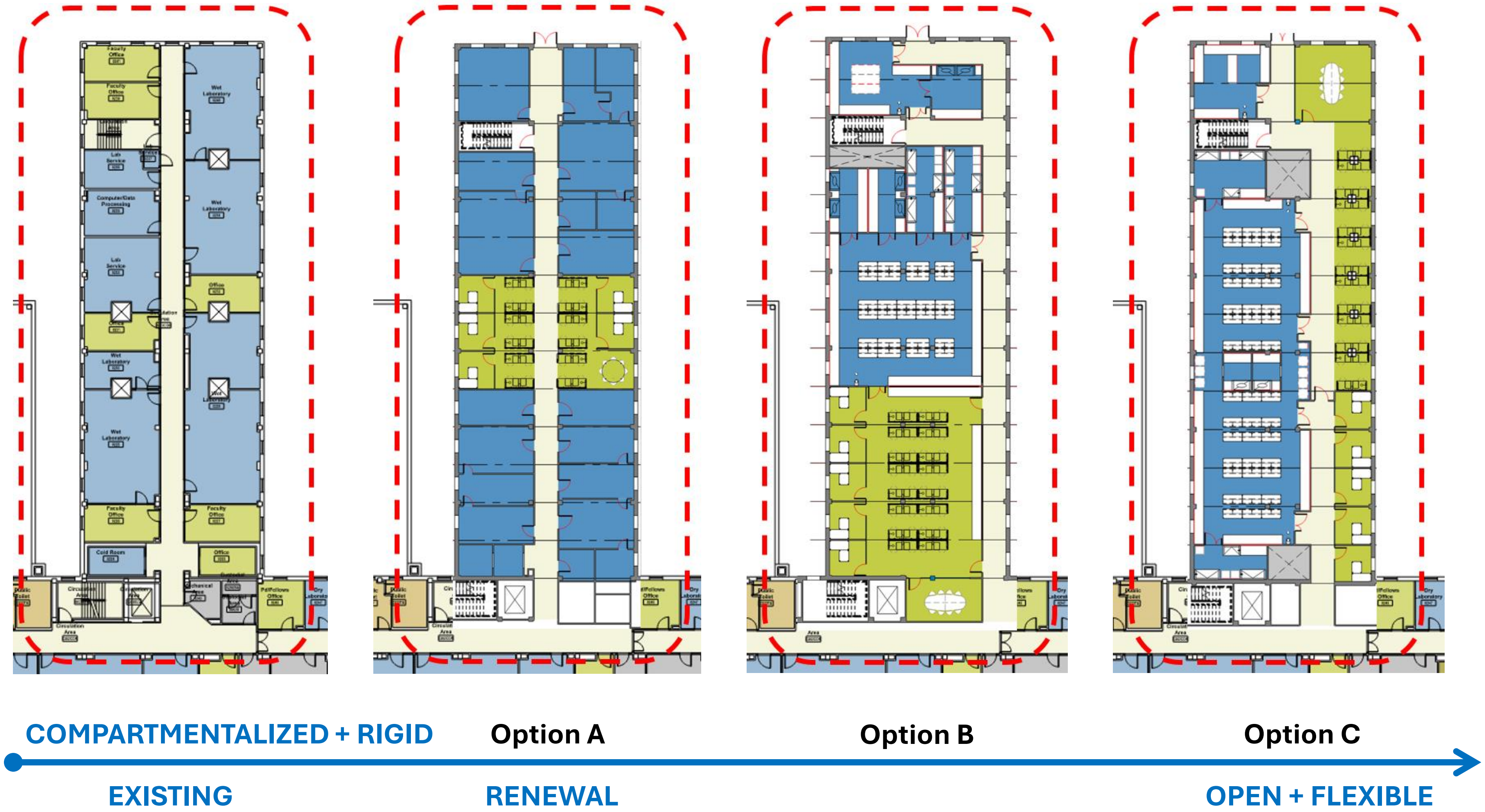
Laboratories	Classrooms	Workplace	Community
900-1200 NSF for Wet Lab	Flexible Learning	Range	Target
600 NSF for Dry Lab	**25-35** NSF Per Student	**100-160** NSF Office	**5-8%** Total NSF

FACILITY FIT – PROGRAM ENHANCEMENTS

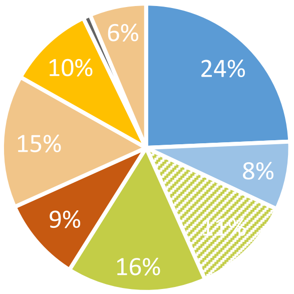
PROGRAM SUITABILITY



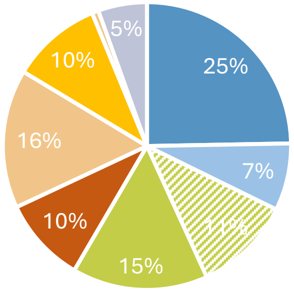


FACILITY FIT

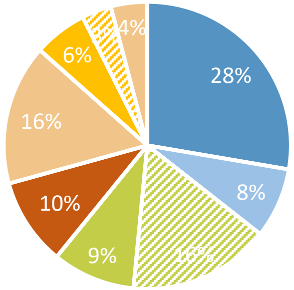
PROGRAM SUITABILITY



EXISTING



RENEWAL



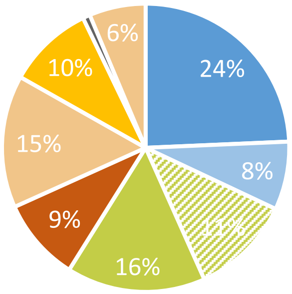
ENHANCEMENTS (BASE+)

BIOLOGICAL SCIENCES BUILDING

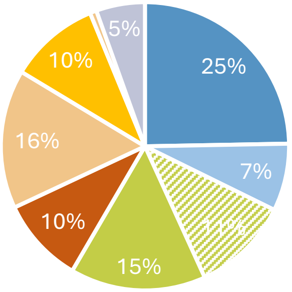
Room Category	Existing		Δ		Renewal (Base)		Base +	Δ	Metrics	Potential Growth
	Quantity / # of Pis	Total NASF	Impacted Program	Impacted Pis	Quantity / # of Pis	Total NASF	Total SF	Base+ - Renewal (Added or Missing Program)		# of PI / People/ Spaces
Wet Lab Research	31	26,252	828	11	20	25,424	27,751	2,327	900-1200	1 to 2
Dry Lab Research	13	8,281	497	3	10	7,784	7,935	151	600	0
Office - Research	-	12,223	984	-	-	11,239	15,988	4,749	390	12
Office - Admin and Faculty	-	16,880	1,218	-	-	15,662	9,349	-6,313	130	-49
Fixed Program (Vivariums)	37	10,085	202	-	36	9,883	9,883	0	-	-
Class Lab	13	16,068	0	-	13	16,068	15,874	-194	60	-3
Classroom - Traditional	12	10,440	0	-	12	10,440	6,037	-4,403	25	-176
Classroom – Active Learning	0	0	0	-	0	0	3,340	3,340	35	95
Social Spaces	3	884	123	-	2	761	4,104	3,343	25	134
Storage	24	6,861	1,225	-	17	5,636	-	-	-	-
Total Transitional Area	1,736		-527		1,209					
Total Program Area	107,974		5,077		102,897		109,827			
Total Building Gross Area	166,601				172,681		172,681			

FACILITY FIT

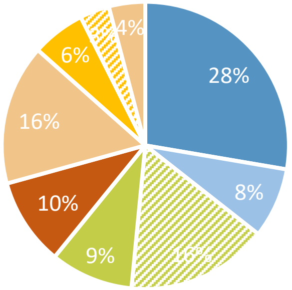
PROGRAM SUITABILITY



EXISTING



RENEWAL



ENHANCEMENTS (BASE+)

Expectations for Renewal

Existing NSF – Shafts, Enlarged Toilet Rooms, MEP = **Reduced NSF**

Existing GSF + Mechanical Penthouses = **Increased GSF**

BIOLOGICAL SCIENCES BUILDING										
Room Category	Existing		Δ		Renewal (Base)		Base +	Δ	Metrics	Potential Growth
	Quantity / # of Pis	Total NASF	Impacted Program	Impacted Pis	Quantity / # of Pis	Total NASF	Total SF	Base+ - Renewal (Added or Missing Program)		# of PI / People/ Spaces
Wet Lab Research	[illegible]	26,252	[illegible]	11	20	25,424	[illegible]	2,327	900-1200	1 to 2
Dry Lab Research	13	8,281	497	3	10	7,784	7,935	151	600	0
Office - Research	-	12,223	984	-	-	11,239	15,988	4,749	390	12
Office - Admin and Faculty	[illegible]	16,880	[illegible]	[illegible]	[illegible]	15,662	9,349	-6,313	130	-49
Fixed Program (Vivariums)	37	10,085	202	-	36	9,883	9,883	0	-	-
Class Lab	13	16,068	0	-	13	16,068	15,874	-194	60	-3
Classroom – Traditional	[illegible]	10,440	0	-	[illegible]	10,440	6,037	-4,403	[illegible]	-176
Classroom – Active Learning	0	0	0	-	0	0	3,340	3,340	35	95
Social Spaces	3	884	123	-	2	761	4,104	3,343	25	134
Storage	24	6,861	1,225	-	17	5,636	-	-	-	-
Total Transitional Area	1,736		-527		1,209					
Total Program Area	107,974		5,077		102,897		109,827			
Total Building Gross Area	166,601				172,681		172,681			

EVALUATION CRITERIA

HISTORIC SIGNIFICANCE

- Multiple Criteria Established by the **National Park Service**
- Representative of the History, Architecture, Archeology, Engineering, or Culture of an Era.

ENVELOPE + STRUCTURE

- **Existing Condition Assessment**
- Exterior Wall Assembly
- Existing Dew Point Analysis
- Structural System + Condition
- Structural Bay Size + Floor to Floor

PROGRAM SUITABILITY

- Existing Program
- **Duke Metrics**
- Future Focus
- Facility Fit

ENERGY AND CARBON

- Existing Conditions
- **Digital Twin Energy Model**
- Systems Options
- Energy + CO_2 Reductions

BASIS FOR ASSESSMENTS & PLANNING

EXISTING SYSTEMS - CONDITIONS OBSERVATIONS

Many of the major systems are past their useful life

Performance/Reliability Challenges

Ongoing failures of piping infrastructure

They do not meet Duke's guidelines or energy goals


Packaged Rooftop - CV


Process Cooling System

Modular AHU -VAV


Outdoor Switchgear


Switchgear in MER

Single Zone AHU

BASIS FOR ASSESSMENTS & PLANNING

EXISTING SYSTEMS - SUITABILITY

Multiple Disparate HVAC Systems

Built to Suit - No Flexibility

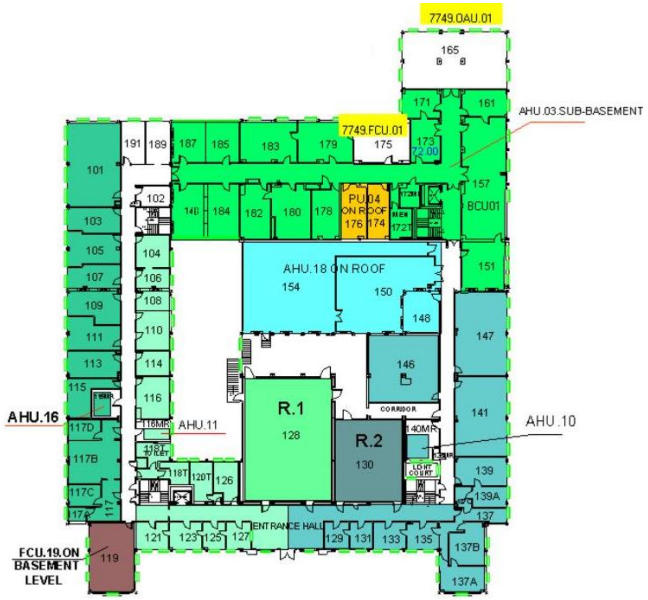
No Redundancy or Cross Connection Opportunities

Limited Capacity / Problems with Humidity Control

Multiple Normal Power Systems

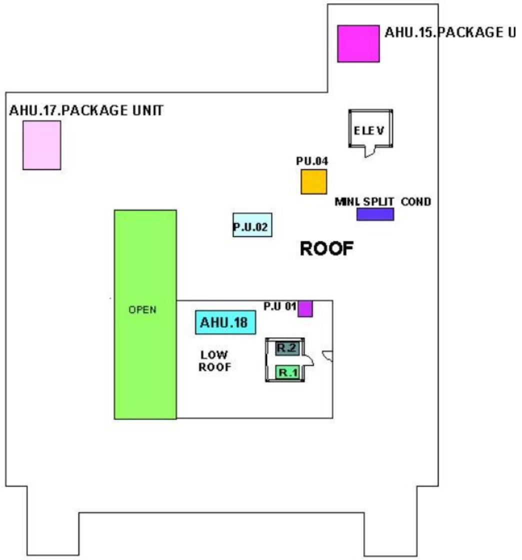
Limited Emergency Power

Physics - Basement



Physics - First Floor

Physics - Second Floor



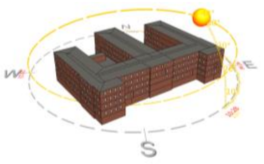
Physics - Roof

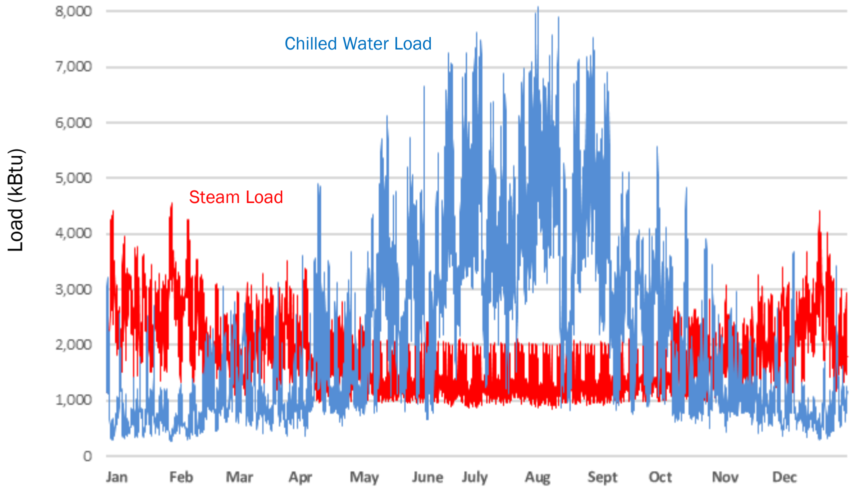
25

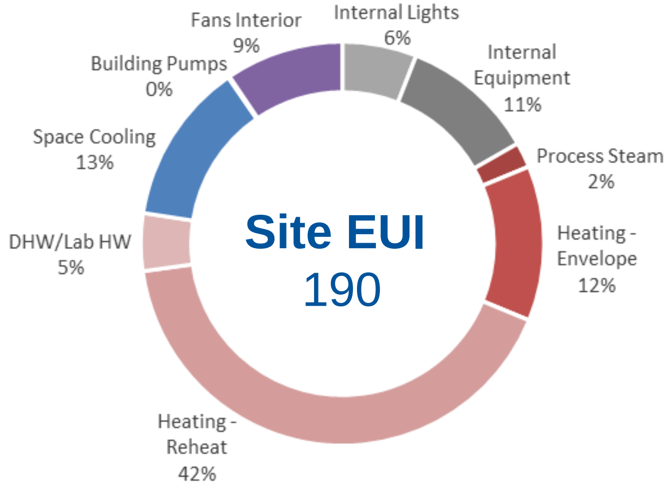
SEPARATE HVAC SYSTEMS

DIGITAL TWIN EXISTING MODEL

BIO SCIENCE

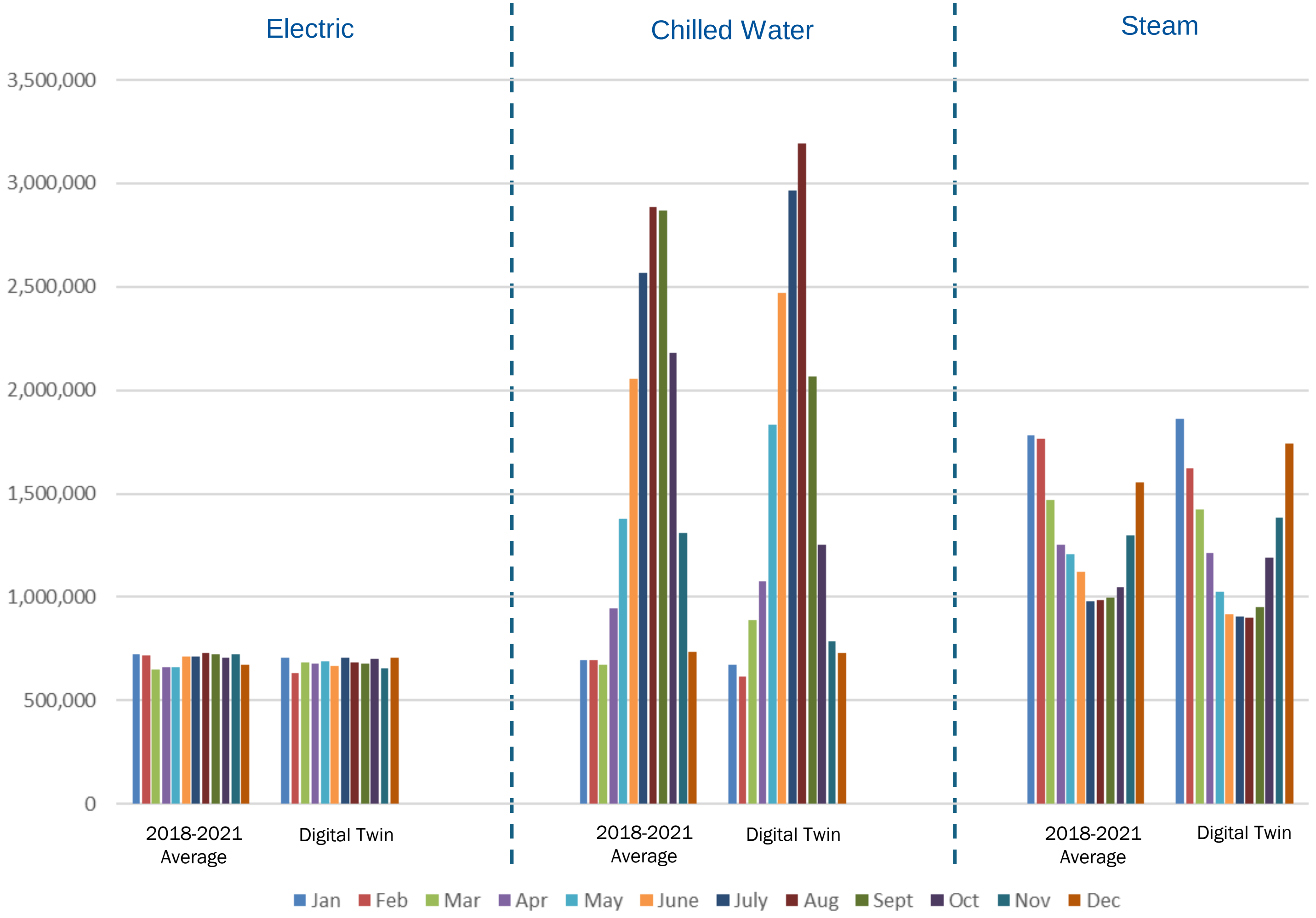






Monthly Energy Usage Comparison

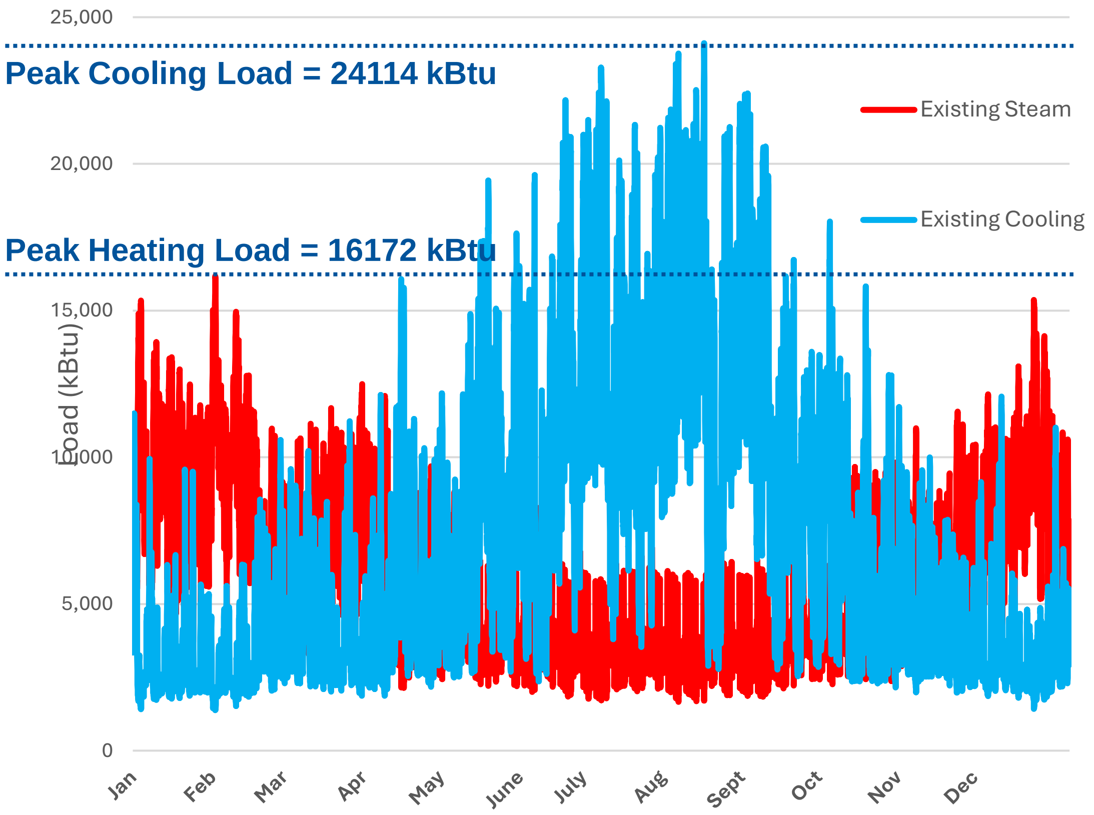
Metered Data vs. Digital Twin Model (kBtu)



DIGITAL TWIN EXISTING MODEL

TOTAL EXISTING ENERGY FOR ALL BUILDINGS

Existing Conditions				
Building	Total CHW (MMBtu)	Total Heating (MMBtu)	Total Elec (MMBtu)	Total CO2 (MT)
Teer	3081	3877	1699	474.7
Social Sciences	2827	2911	1478	383.1
Rueben Cook	4755	4291	2338	588.9
Physics	16295	12596	5608	1663.3
Old Chem	6854	6480	2451	790.9
Language	1535	1970	730	229.2
Hudson	5364	6401	4753	955.8
Engineering Addition	2193	2653	1957	394.5
Bio Sci.	18476	15502	8341	2142
Total	61380	56681	29355	7622.4



AVERAGE SITE EUI FOR ALL 9 BUILDINGS = 168.9

BASIS FOR ASSESSMENTS & PLANNING

REPLACEMENT SYSTEM GOALS

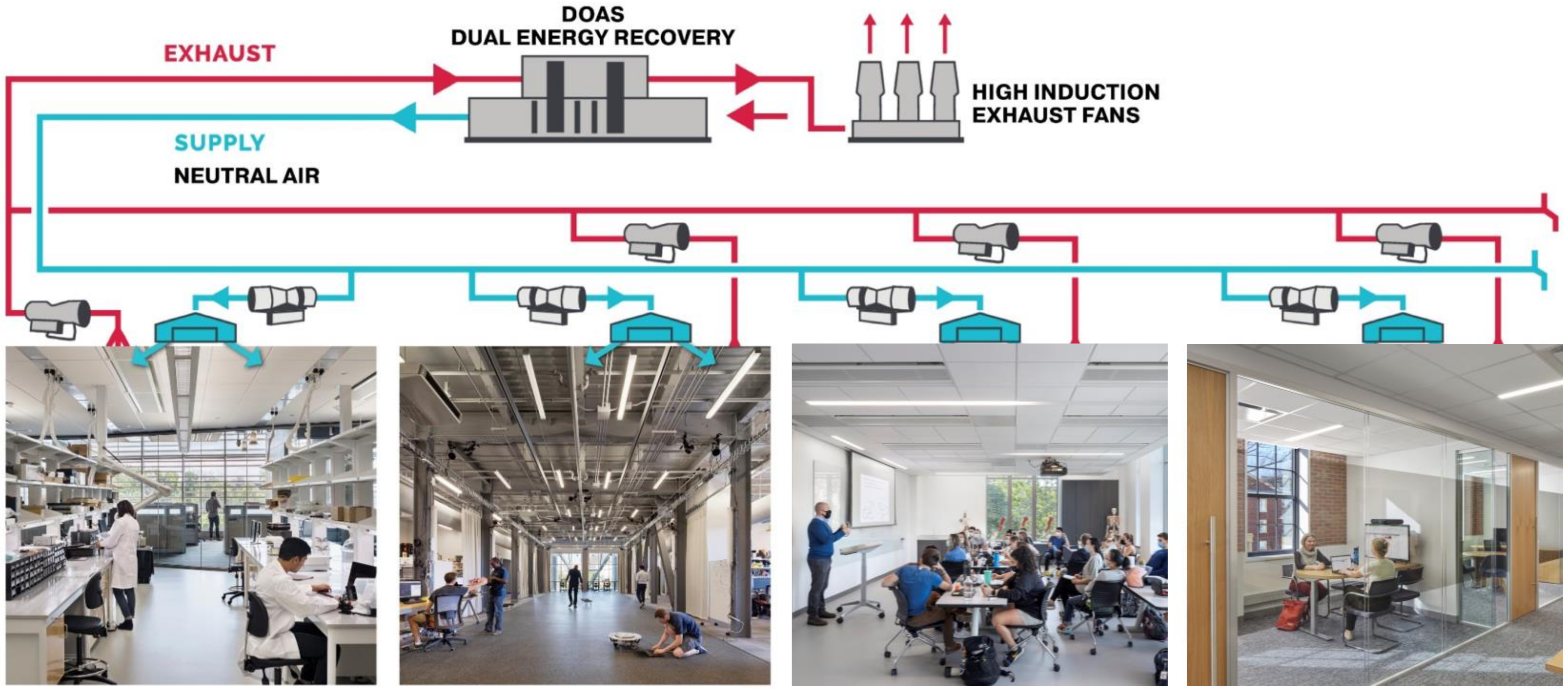
Suitability

Flexibility

Reliability

Resiliency

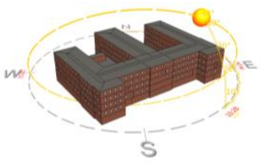
Sustainability



Wet Lab | Dry Lab | Classroom | Office

TESTED THREE SYSTEMS

- HIGH PERFORMANCE VAV
- DOAS W/ ENERGY RECOVERY COILS
- DOAS W/ ENERGY RECOVERY WHEELS



DIGITAL TWIN PROPOSED SYSTEMS

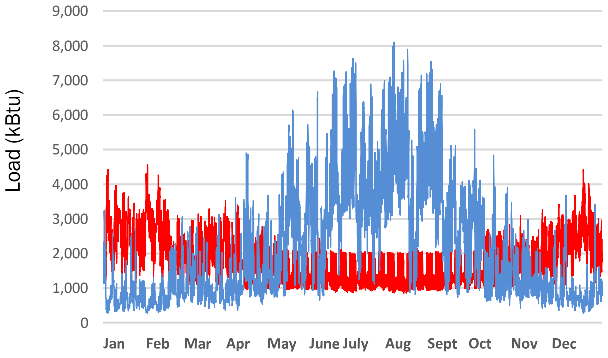
BIOSCIENCE

Annual Heating + Cooling Load Profile Transition

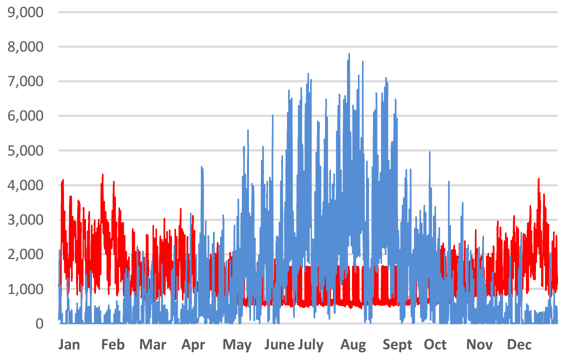
Existing Building vs. Major Systems Retrofit vs. Major Renovation

*Currently assumes equivalent space program

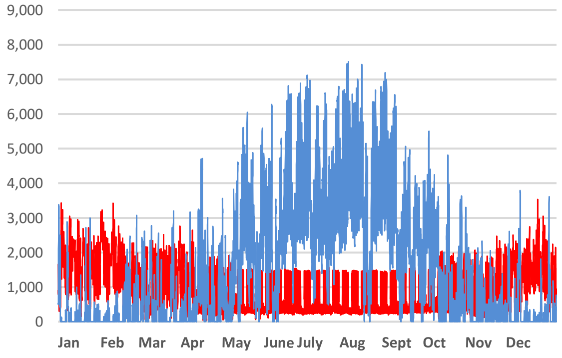
Existing Building



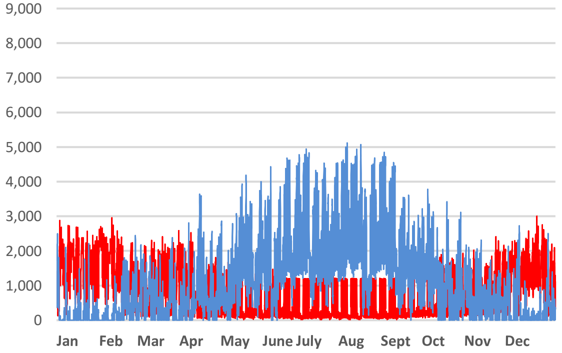
High Performance VAV

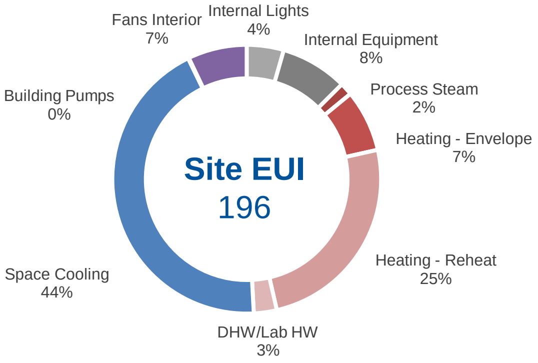


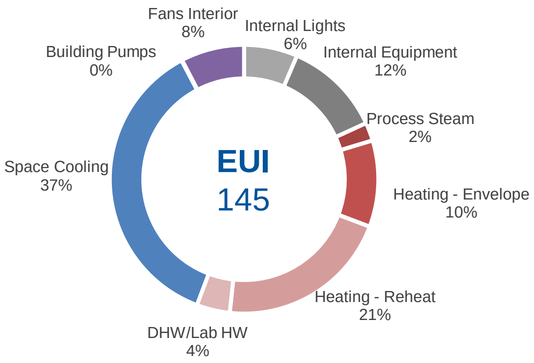
Decoupled Systems Energy Recovery Coils

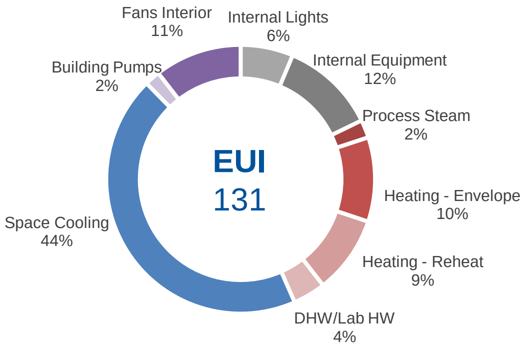


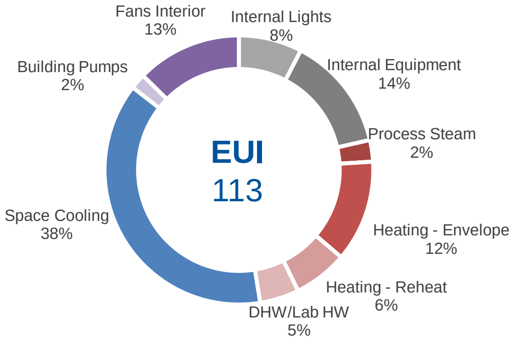
Decoupled Systems Energy Recovery Wheels







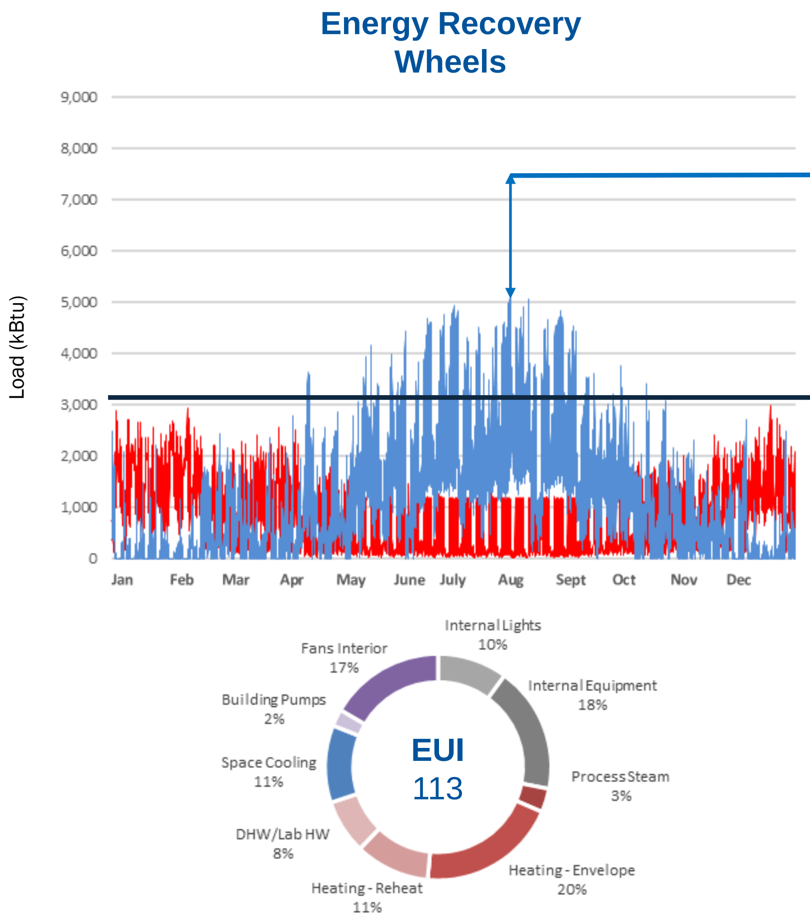


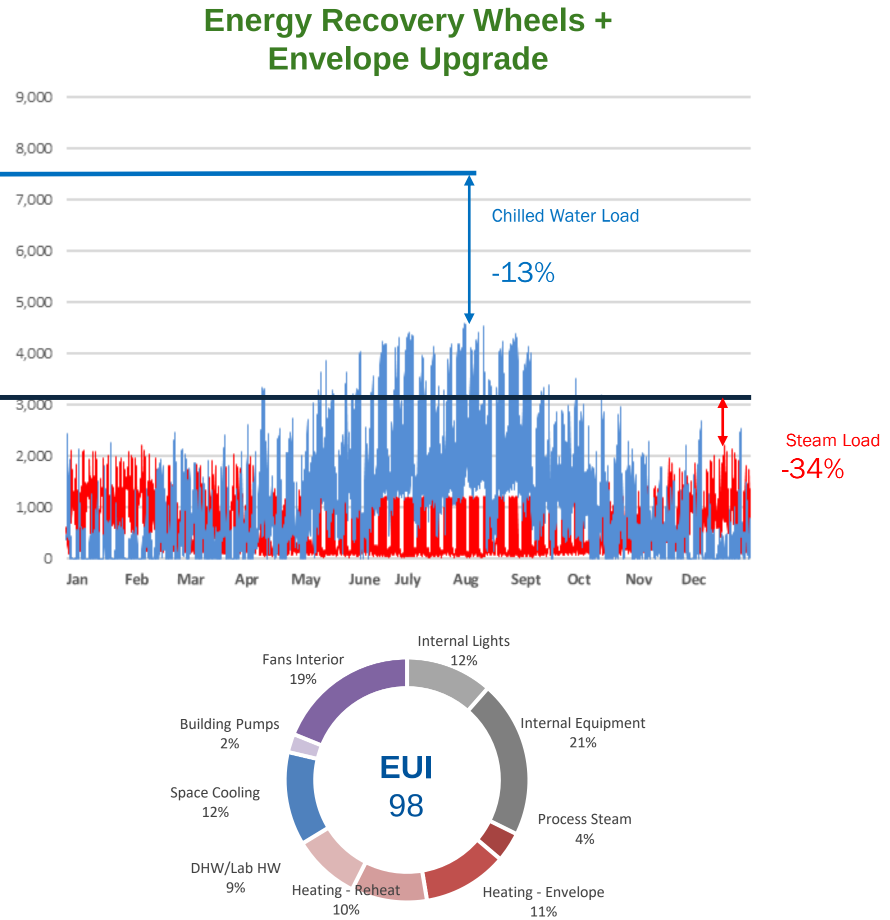


DIGITAL TWIN ENVELOPE

BIOSCIENCE

Annual Heating + Cooling Load Profile Transition



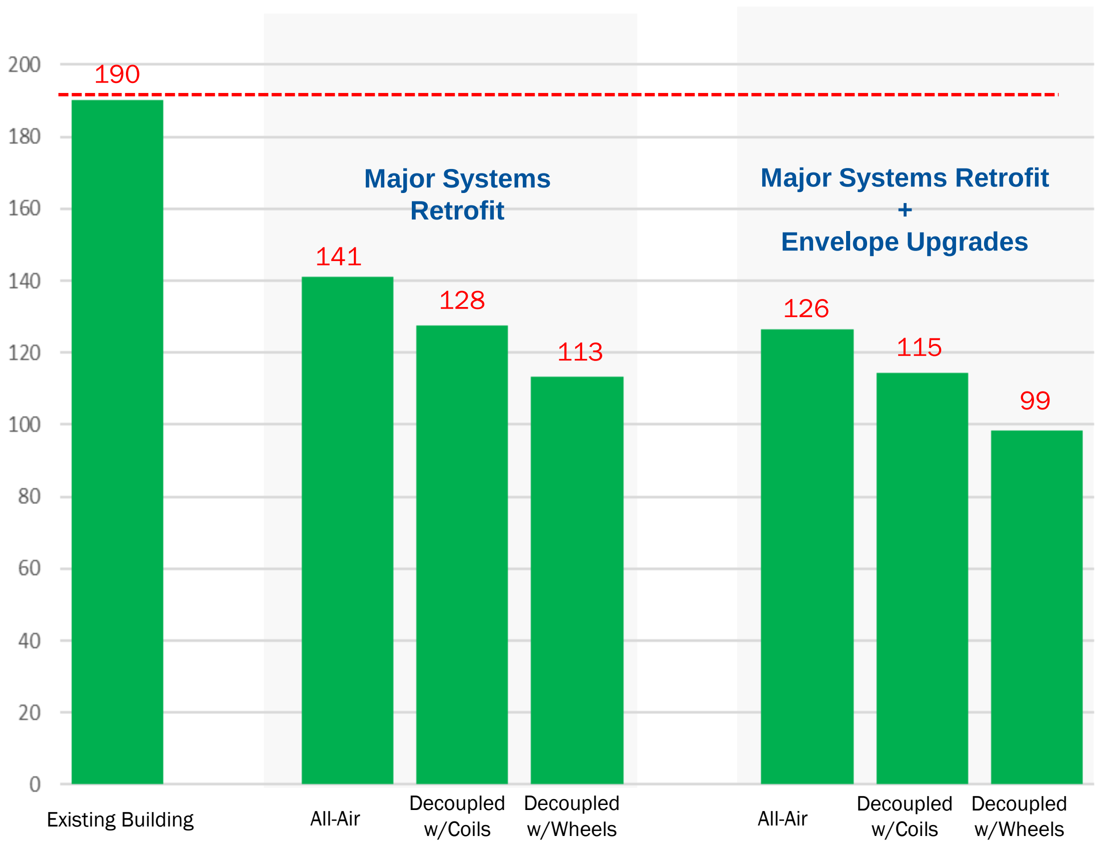


DIGITAL TWIN ENERGY & CARBON

BIOSCIENCE

Energy Utilization Intensity (EUI, kBtu/GSF/Year) Comparison

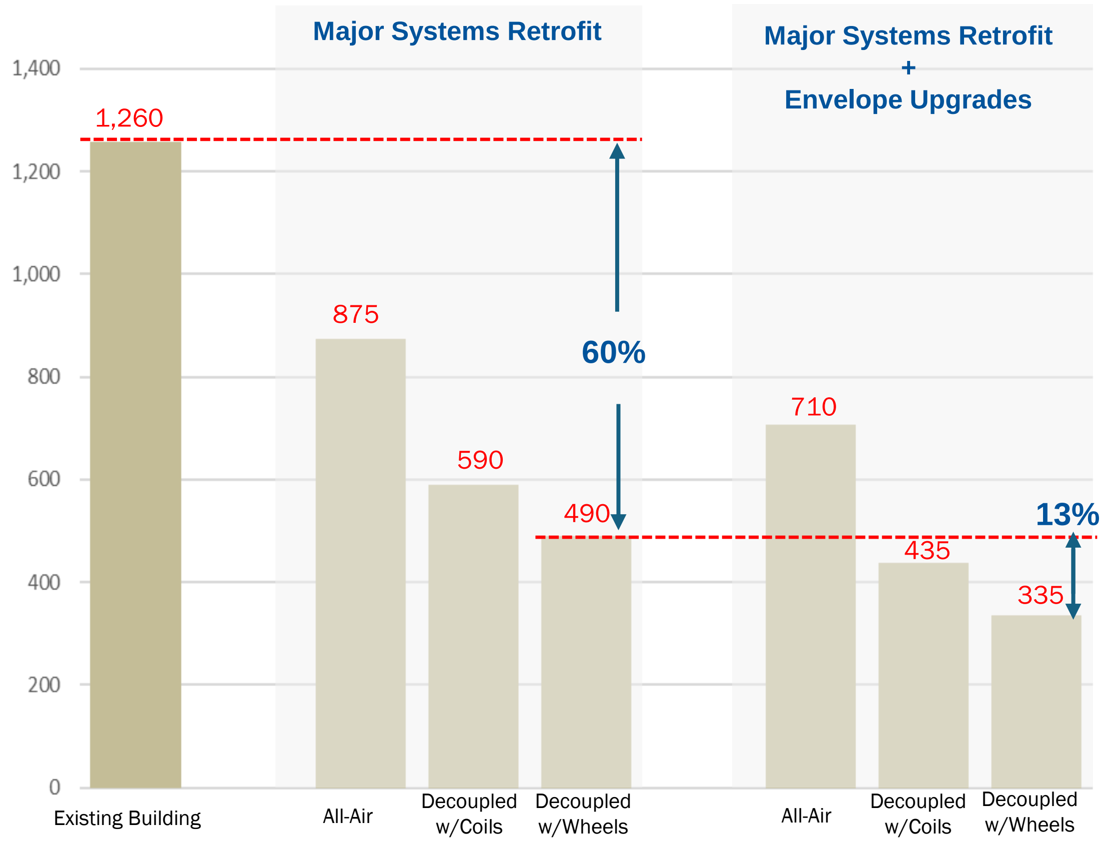
Existing Building vs. Major Systems Retrofit vs. Major Renovation



- 40% reduction in Energy Use Intensity (EUI)
- Additional 13% reduction due to envelope upgrades (window and frame replacement).

Fossil Fuel Carbon Emission Comparison

Existing Building vs. Major Systems Retrofit vs. Major Renovation

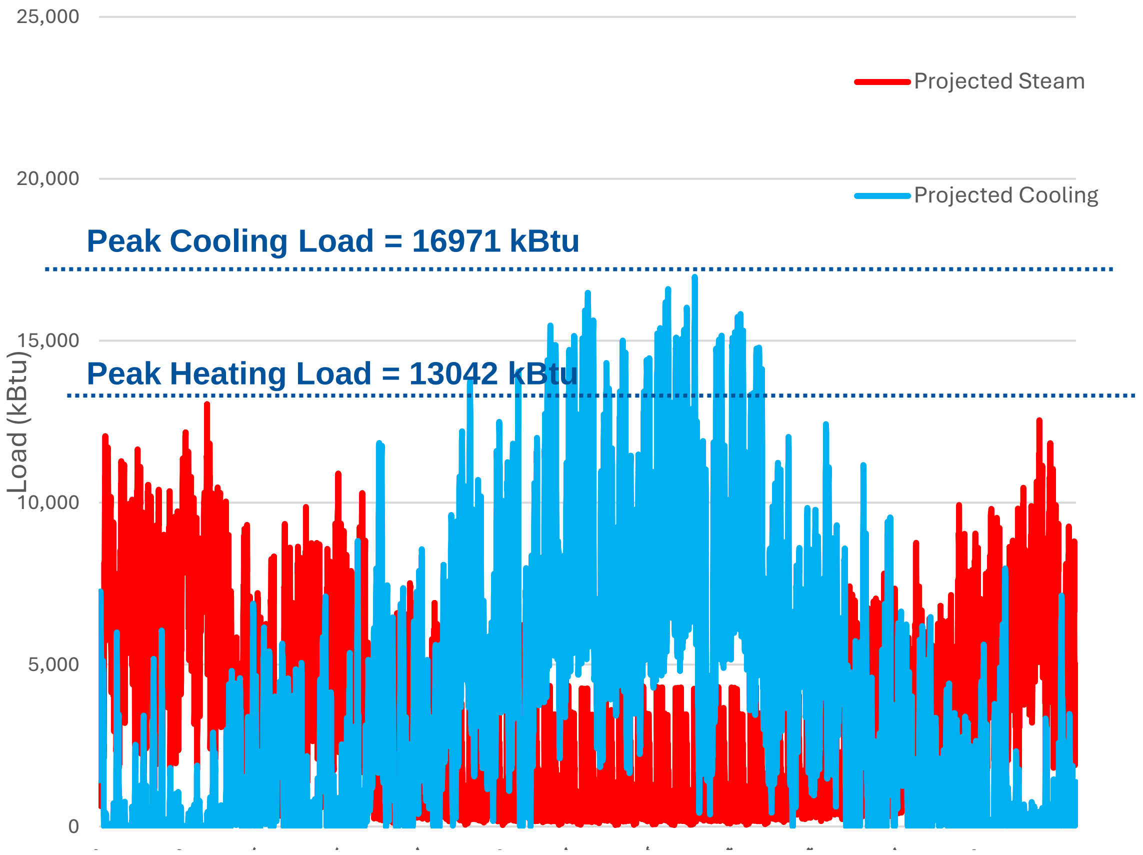


- 60% reduction in fossil fuel emissions due to system upgrades
- Additional 13% reduction due to envelope upgrades

DIGITAL TWIN ENERGY & CARBON – NO SOURCE CHANGE

TOTAL PROPOSED ENERGY FOR ALL BUILDINGS

Existing Conditions				
Building	**Total CHW (MMBtu)**	**Total Heating (MMBtu)**	**Total Elec (MMBtu)**	**Total CO2 (MT)**
Teer	1866	3056	1081	341.9
Social Sciences	2569	2795	1289	354
Rueben Cook	3243	2415	2195	417.1
Physics	4098	3316	4378	683.4
Old Chem	2965	2696	2215	433.6
Language	1013	1060	579	142.7
Hudson	4308	4270	3191	652.6
Engineering Addition	1997	1212	1760	272.5
Bio Sci.	9413	6443	8887	1386.7
Total	31472	27263	25575	4684.5
Existing Total	61380	56681	29355	7622.4
% Reduction	48.7%	51.9%	12.8%	38.5%



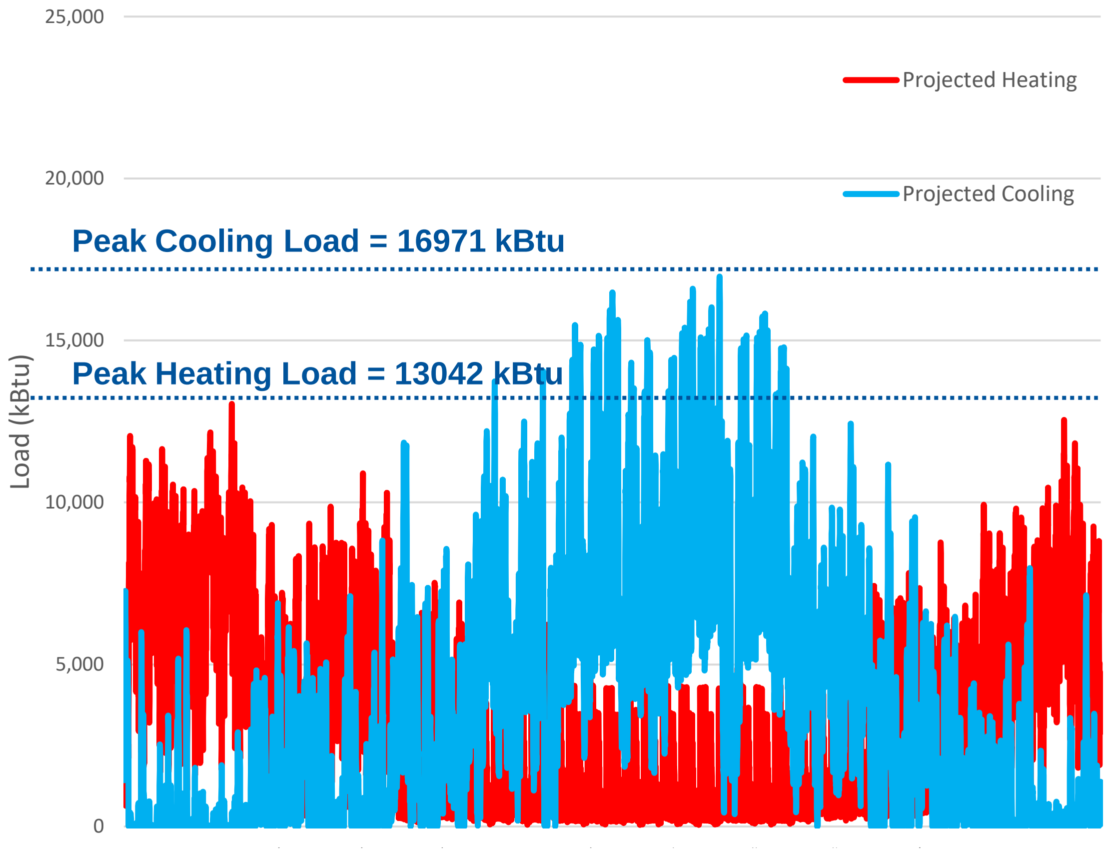
AVERAGE EUI FOR ALL 9 BUILDINGS = 97.7
REDUCTION IN AVERAGE SITE EUI = 42.2%

38.5% Annual CO2 Savings

FULL BUILDING ELECTRIFICATION

AFTER CAMPUS HOT WATER CONVERSION

Existing Conditions				
Building	**Total CHW (MMBtu)**	**Total Heating (MMBtu)**	**Total Elec (MMBtu)**	**Total CO2 (MT)**
Teer	1866	3056	1081	207.9
Social Sciences	2569	2795	1289	236.2
Rueben Cook	3243	2415	2195	329.7
Physics	4098	3316	4378	541.7
Old Chem	2965	2696	2215	323.1
Language	1013	1060	579	101.0
Hudson	4308	4270	3191	464.7
Engineering Addition	1997	1212	1760	216.0
Bio Sci.	9413	6443	8887	1092.5
Total	31472	27263	25575	3512.8
Existing Total	61380	56681	29355	7622.4
% Reduction	48.7%	51.9%	12.8%	53.4%



AVERAGE EUI FOR ALL 9 BUILDINGS = 62.0
REDUCTION IN AVERAGE SITE EUI = 62.9%

53.4% Annual CO2 Savings

BASIS FOR ASSESSMENTS & PLANNING

EVALUATION CRITERIA

Historic Significance
Envelope + Structure
Program Suitability
Energy + Carbon

● High Value

◒ Medium to High Value

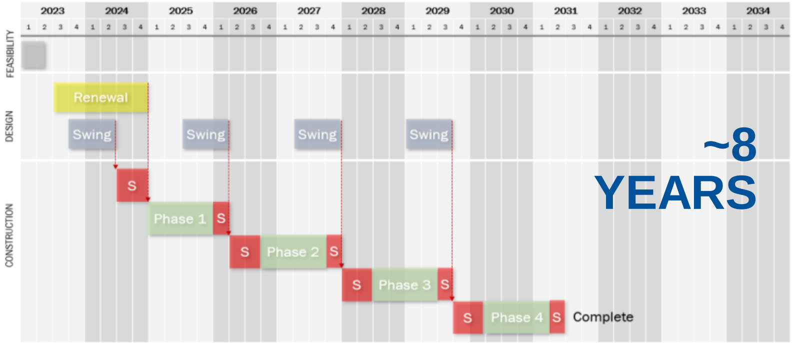
○ Low to Medium Value

Type	Building	Year	Historic Value	Envelope + Structure	Program Suitability	Energy + Carbon	Overall Score
Office + Classrooms	Reuben-Cooke	1931	●	◒	●	◒	●
	Old Chem	1930	●	◒	●	◒	●
	Languages	1929	●	◒	●	◒	●
	Social Sciences	1931	●	◒	●	◒	●
Research + Class Lab	Hudson	1948	◒	◒	◒	◒	◒
	Physics	1949	◒	◒	○	◒	◒
	Biological Sciences	1962	◒	◒	◒	◒	◒
	Hudson Annex	1973	○	○	○	◒	○
	Teer	1984	○	○	○	◒	○

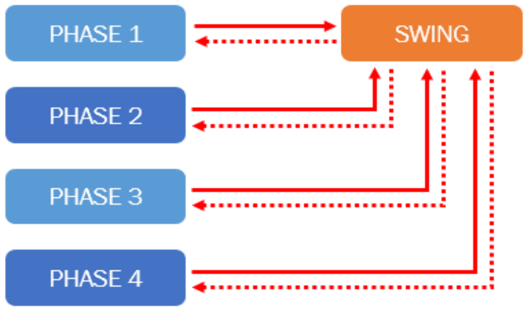
ADDITIONAL CONSIDERATIONS

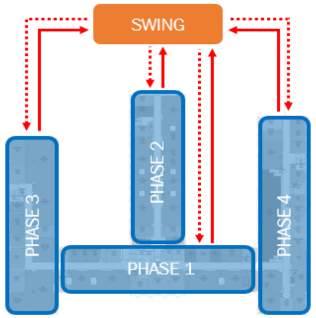
SWING SPACE + SCHEDULE

BACK AND FORTH / MULTIPLE PHASES

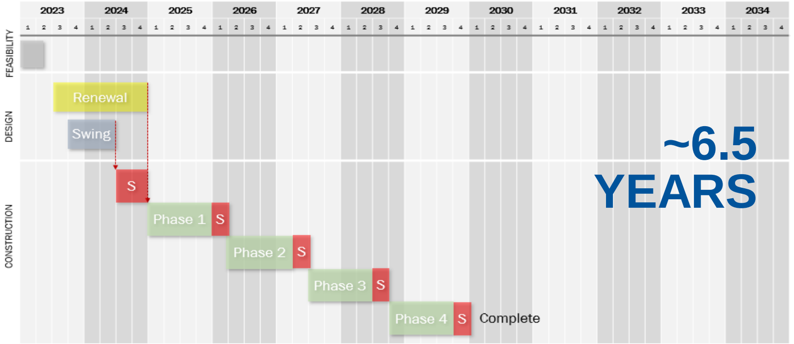


~8 YEARS

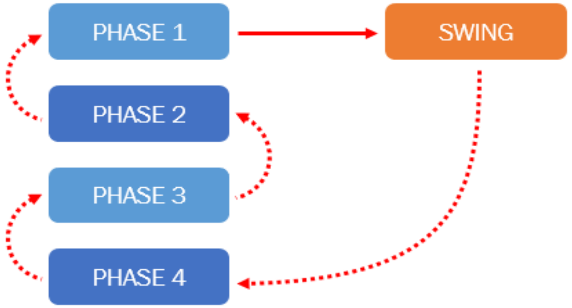


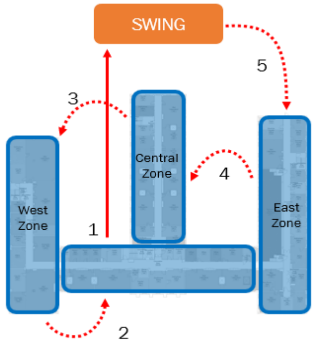


MOVE ON DOWN THE LINE / MULTIPLE PHASES

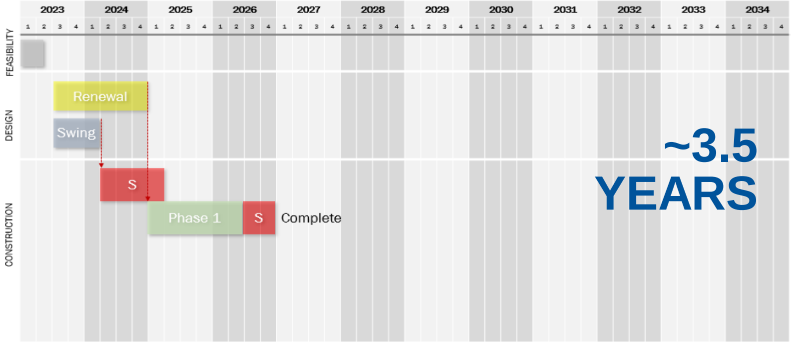


~6.5 YEARS

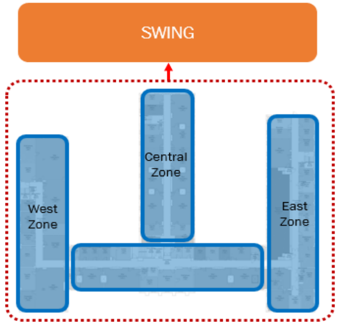




SINGLE PHASE



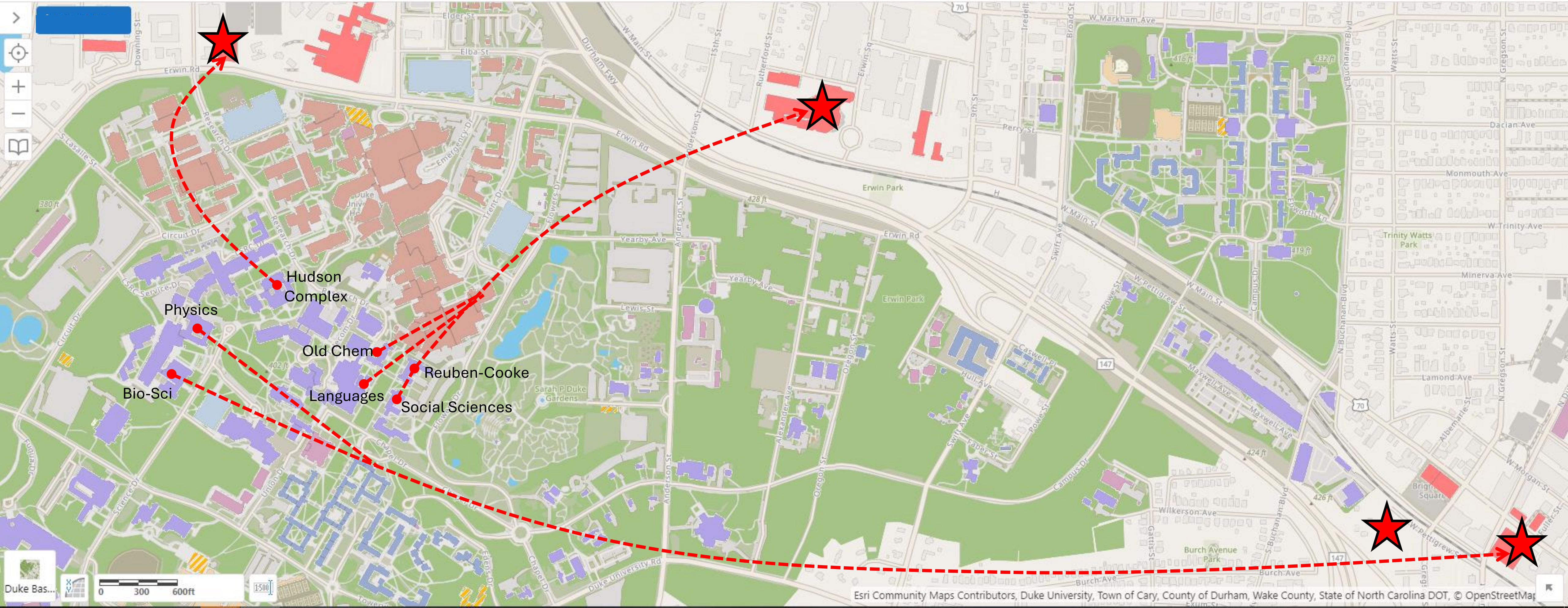
~3.5 YEARS



ADDITIONAL CONSIDERATIONS

SWING SPACE

~~On Campus~~	**Existing Building** (Off Campus Lease)	~~Modular~~	**New Building** (Off Campus Lease)



ITEM FOUR

SUMMARY & NEXT STEPS

ITEM ONE

INTEGRATED PLANNING IS KEY

ITEM ONE

INTEGRATED PLANNING IS KEY

ITEM TWO

SET EXPECTATIONS EARLY FOR FACULTY

ITEM ONE

INTEGRATED PLANNING IS KEY

ITEM TWO

SET EXPECTATIONS EARLY FOR FACULTY

ITEM THREE

INVOLVE TRUSTEES

ITEM ONE

INTEGRATED PLANNING IS KEY

ITEM TWO

SET EXPECTATIONS EARLY FOR FACULTY

ITEM THREE

INVOLVE TRUSTEES

ITEM FOUR

RIGHT IS MORE IMPORTANT THAN ON TIME

ITEM ONE

INTEGRATED PLANNING IS KEY

ITEM TWO

SET EXPECTATIONS EARLY FOR FACULTY

ITEM THREE

INVOLVE TRUSTEES

ITEM FOUR

RIGHT IS MORE IMPORTANT THAN ON TIME

ITEM FIVE

IT’S AN ITERATIVE PROCESS

SCUP PRESENTATION

QUESTIONS & ANSWERS