Energy Efficient IAQ Mini-Bid Preliminary Report No. 1

Presented to:

NYSERDA

JULY 23, 2020

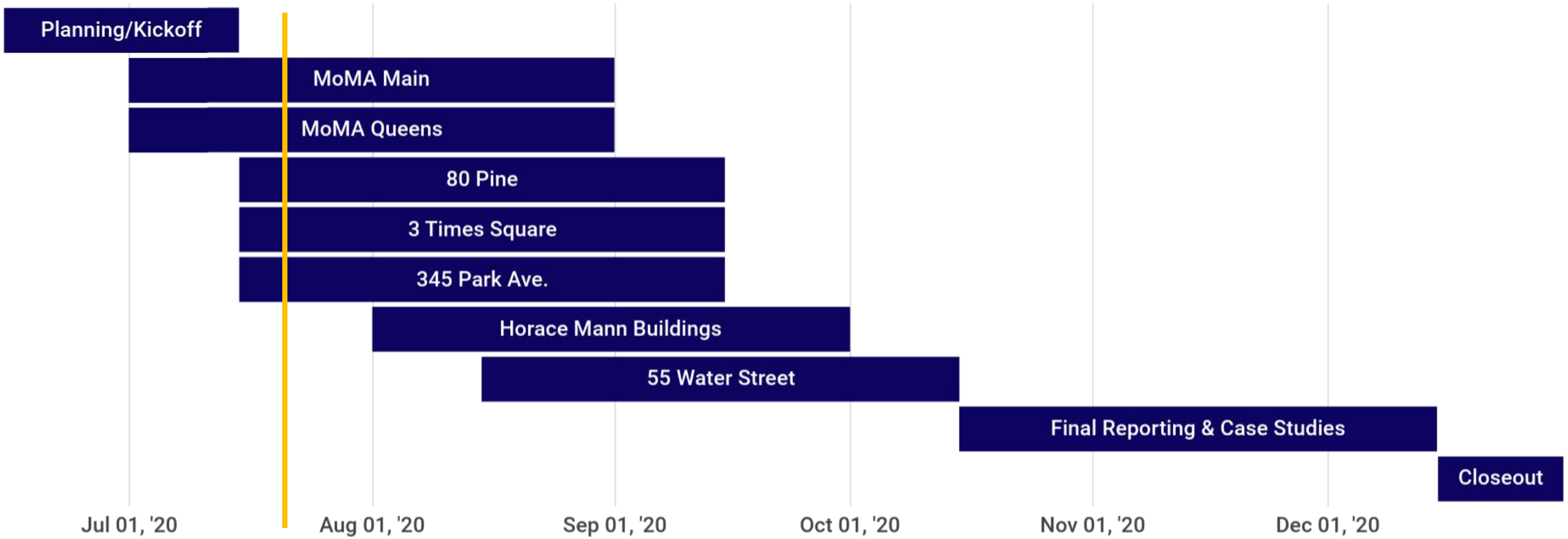
AGENDA

- Housekeeping Items
- MoMA Main Update
- MoMA QNS Update
- Next Steps

HOUSEKEEPING ITEMS

SCHEDULE UPDATE

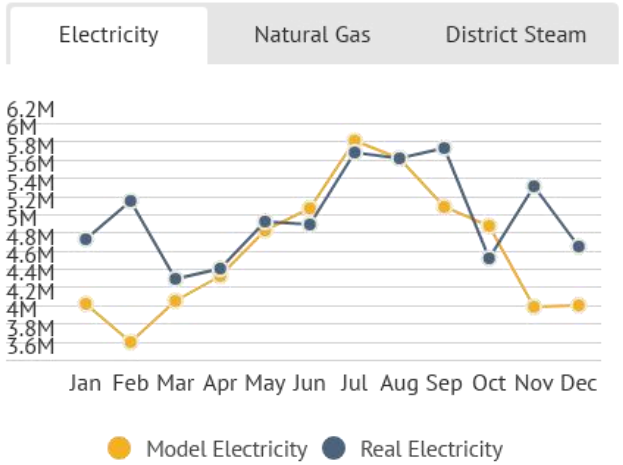
Progress to Date



ENERGY MODELING PACKAGES

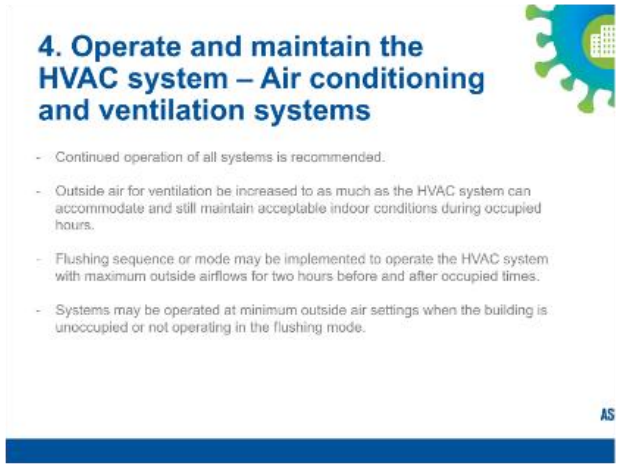
Current Understanding

Baseline Energy Model



- Pre-COVID facility energy use
- Operation assuming 100% occupancy

ASHRAE Recommendations Model



- ASHRAE Commercial Guidance document
- MERV-13/14 filters
- Highest % OA possible during Occupied hours
- Flushing sequence for 2 hrs before/after Occupied hours
- No DCV
- Case-by-case ERV

Energy Efficiency Model

- Base Upgrade Package: UV & suggested ventilation level mods
- Additional Energy Efficiency Package: Filtration level mods, control sequence, additional monitoring, etc.

MOMA MAIN

MOMA MAIN TASK LIST STATUS

Data Collection & Review

- ☑ Minimum 12-Months Pre-COVID Utility Data
- ☑ Existing Building MEP Drawings
- ☑ BMS Sequence of Ops
- ☑ Conduct Preliminary Site Walkthrough
- ☐ Conduct Operator Interviews **(Ongoing)**

Develop Baseline Energy Model

- ☑ Total Annual Energy Use Breakdown by End Use
- ☑ Benchmark Building
- ☑ Develop Preliminary ECMs

Site Survey & Energy Efficient IAQ Recommendations

- ☐ Conduct Detailed Site Visits **(Scheduled)**
- ☐ Develop Filtration and Airside Equipment Operation Log
- ☐ Develop IAQ Recommendations
- ☐ Refine Preliminary ECMs

Energy Efficient IAQ Energy Analysis

- ☐ ASHRAE Recommendations Energy Model
- ☐ Energy Efficiency Model

Economic Analysis

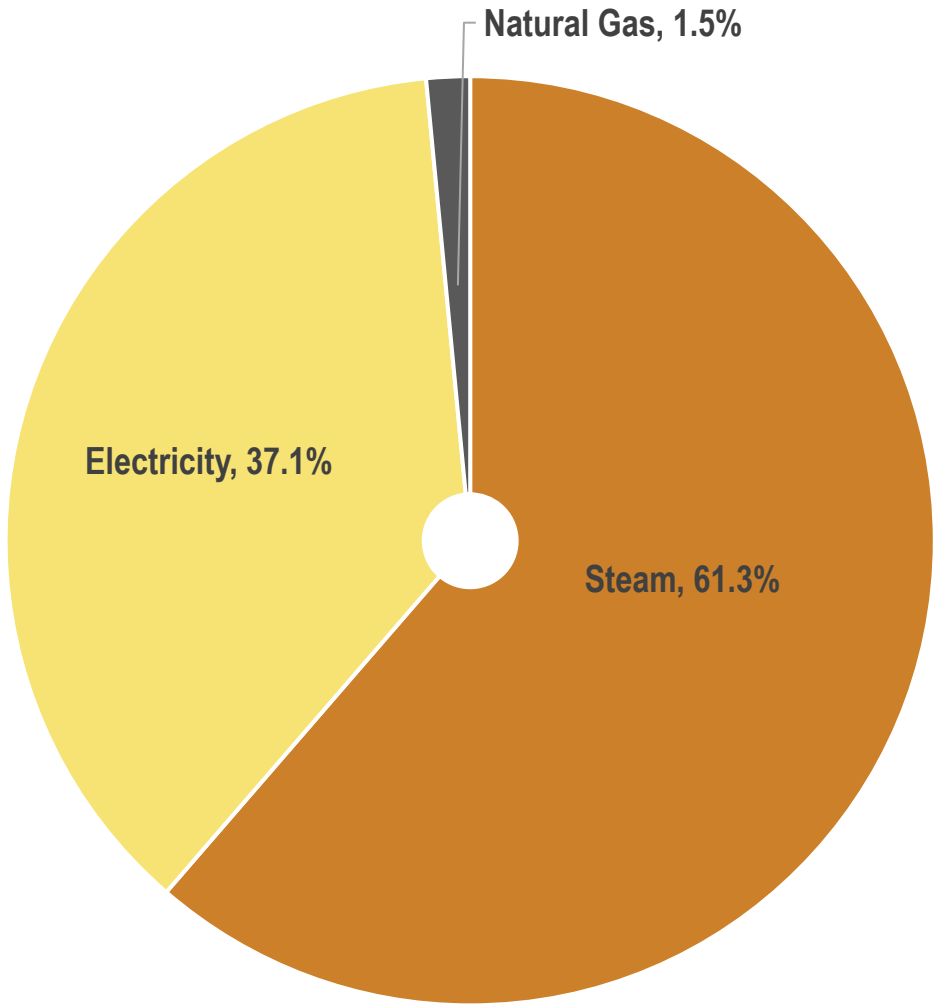
- ☐ Develop Design Document for Cost Estimator
- ☐ Collect Cost Estimates
- ☐ Conduct Economic Analysis

Final Reporting

- ☐ Final Report
- ☐ Case Study Documentation

BASELINE ENERGY MODEL

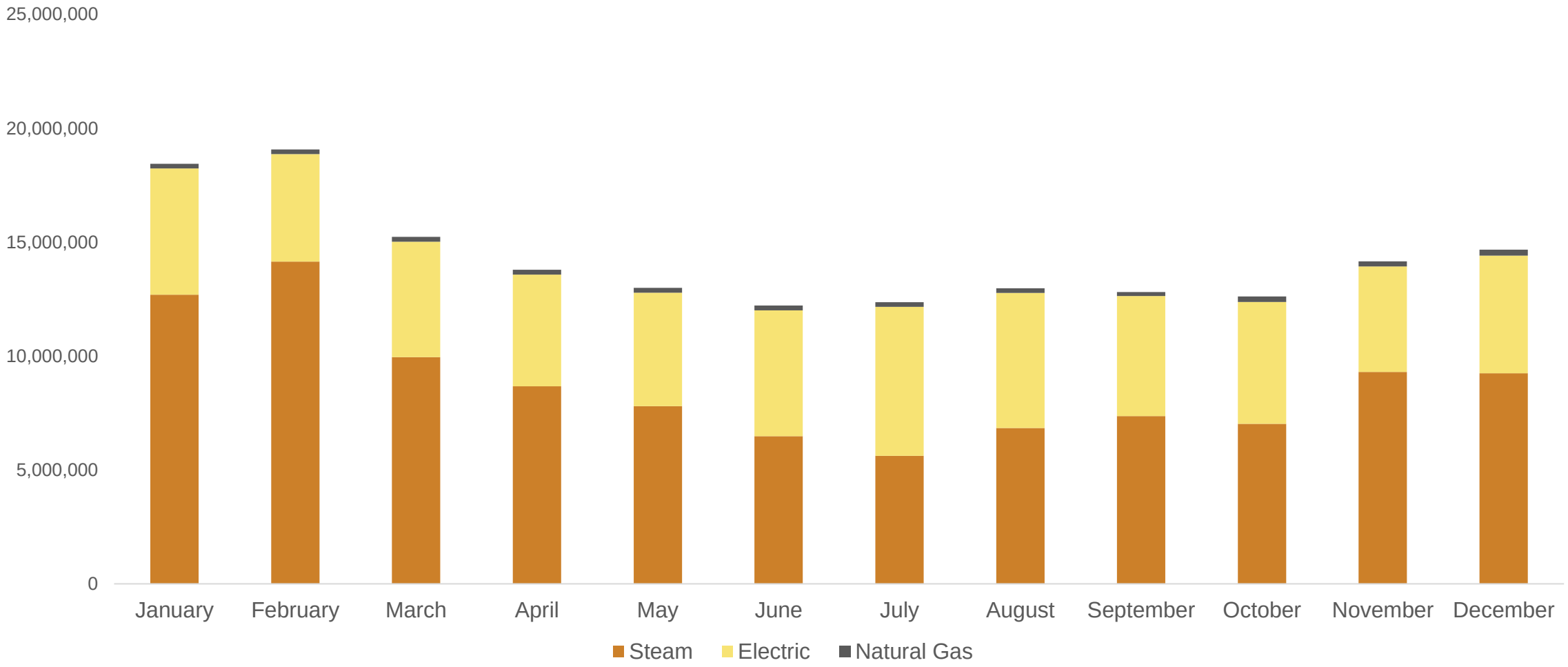
2019 Energy Consumption by Utility



Energy Source	Energy Consumption [kBTUs]	% Energy Consumption
Electricity	63,630,436	37.1%
ConEd Steam	105,128,235	61.4%
Natural Gas	2,601,160	1.5%

BASELINE ENERGY MODEL

Total 2019 Monthly Consumption by Utility [kBtu]

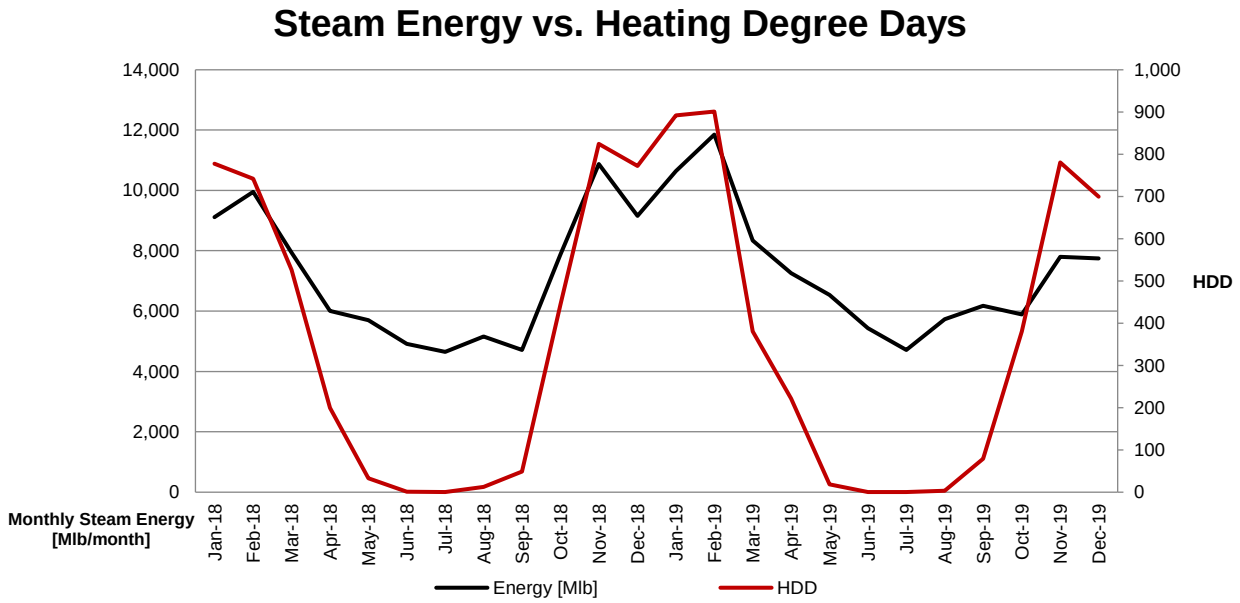


Total 2019 Consumption: 171,397,290 kBtu

BASELINE ENERGY MODEL

Steam

Year	Month	Energy [ConEd Mlb]	Cost [$]	Days	HDD
2018	January	9,113	304,446	28	777
2018	February	9,954	294,190	32	742
2018	March	7,939	232,944	27	526
2018	April	6,005	90,059	29	200
2018	May	5,694	71,400	31	33
2018	June	4,914	63,639	29	1
2018	July	4,651	63,854	28	0
2018	August	5,159	72,203	31	13
2018	September	4,708	65,858	28	49
2018	October	7,873	237,458	29	444
2018	November	10,878	296,350	32	825
2018	December	9,150	269,167	29	772
2019	January	10,635	368,815	28	892
2019	February	11,849	372,858	32	901
2019	March	8,335	264,571	27	381
2019	April	7,262	98,595	29	222
2019	May	6,534	82,226	31	19
2019	June	5,433	62,525	29	0
2019	July	4,710	53,969	28	0
2019	August	5,731	62,297	31	3
2019	September	6,171	70,650	29	79
2019	October	5,884	172,399	28	381
2019	November	7,793	204,592	32	781
2019	December	7,742	218,093	29	699



Notes:

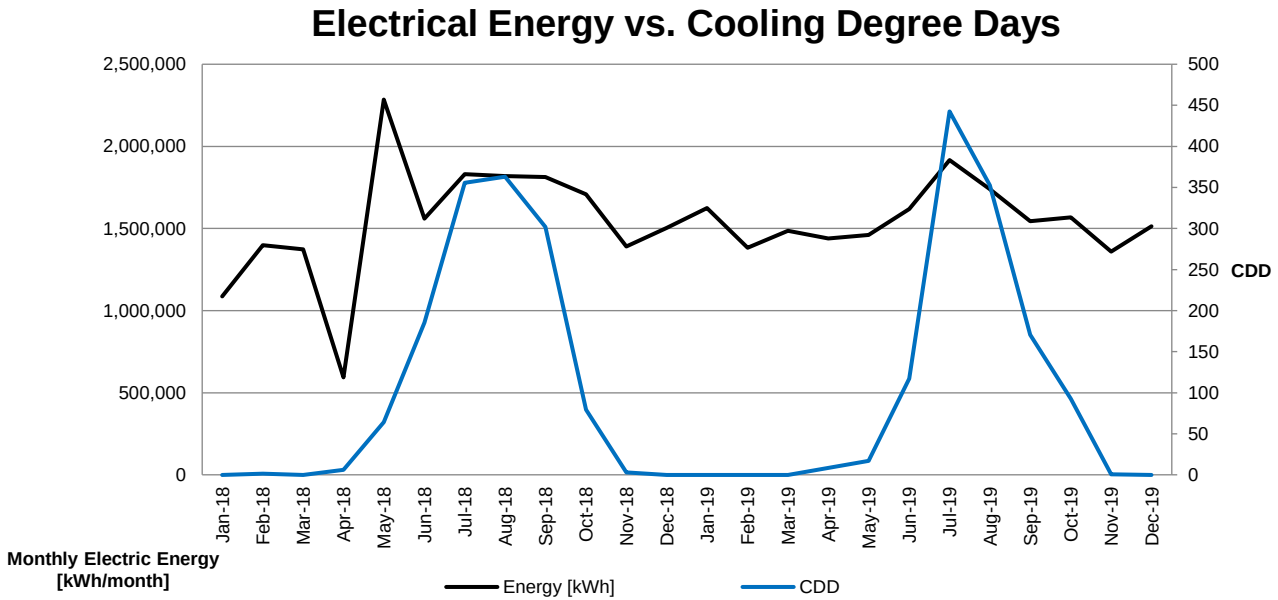
1. A regression analysis was utilized to develop a baseline energy model for heating end uses in the building. This analysis often allows the energy auditing team to better understand the facilities' heating energy profile and will form the analytical foundation for energy reduction analysis associated with ECMs impacting building heating loads.

2. **Insight:** The regression analysis shows that MoMA Main's steam profile follows an expected trajectory, with steam usage driven by outside air temperature in the winter and humidity control requirements year-round.

BASELINE ENERGY MODEL

Electricity

Year	Month	Energy [kWh]	Power [kW]	Cost [$]	Days	CDD
2018	January	1,086,787	2,536	132,977	22	0
2018	February	1,397,600	2,556	158,946	29	2
2018	March	1,372,000	2,340	163,818	28	0
2018	April	593,600	2,649	98,417	30	6
2018	May	2,284,800	2,866	232,010	28	64
2018	June	1,559,200	3,000	237,675	29	186
2018	July	1,831,200	3,185	293,835	30	356
2018	August	1,818,400	3,218	283,606	28	363
2018	September	1,812,800	3,244	290,751	29	302
2018	October	1,707,200	3,070	216,614	31	80
2018	November	1,389,600	2,621	164,010	28	3
2018	December	1,503,200	2,827	173,016	30	0
2019	January	1,623,414	2,532	202,843	33	0
2019	February	1,383,200	2,575	161,646	29	0
2019	March	1,486,400	2,701	181,397	30	0
2019	April	1,438,400	2,651	168,932	28	9
2019	May	1,460,800	2,845	172,158	28	17
2019	June	1,618,400	3,015	243,364	29	117
2019	July	1,916,800	3,138	302,819	31	443
2019	August	1,738,400	3,079	274,834	28	353
2019	September	1,544,000	2,951	260,444	29	171
2019	October	1,567,200	2,856	220,536	31	93
2019	November	1,358,400	2,865	175,505	28	1
2019	December	1,513,600	2,502	194,895	32	0



Notes:

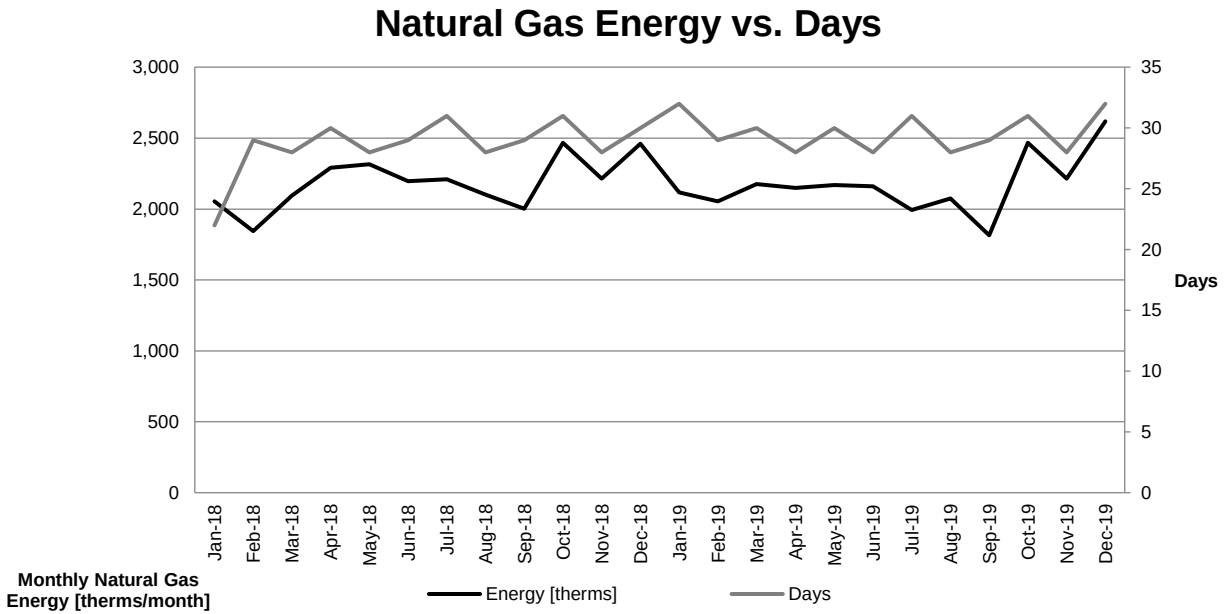
1. A regression analysis was utilized to develop a baseline energy model for cooling end uses in the building. This analysis often allows the energy auditing team to better understand the facilities' cooling energy profile and will form the analytical foundation for energy reduction analysis associated with ECMs impacting building cooling loads.

2. **Insight:** The regression analysis shows that MoMA's cooling energy profile is consistent year-round due to the stringent temperature and humidity requirements for Museum gallery spaces. Peaks in the summer months are due to additional cooling load as outside temperatures rise.

BASELINE ENERGY MODEL

Natural Gas

Year	Month	Energy [therm]	Cost [$]	Days
2018	January	2,054	1,455	22
2018	February	1,844	1,837	29
2018	March	2,094	2,145	28
2018	April	2,291	2,340	30
2018	May	2,315	2,341	28
2018	June	2,197	2,208	29
2018	July	2,211	2,233	31
2018	August	2,101	2,116	28
2018	September	2,003	2,004	29
2018	October	2,467	2,484	31
2018	November	2,215	2,232	28
2018	December	2,461	2,478	30
2019	January	2,118	2,334	32
2019	February	2,054	1,891	29
2019	March	2,177	1,899	30
2019	April	2,150	1,851	28
2019	May	2,169	1,869	30
2019	June	2,160	1,861	28
2019	July	1,994	2,815	31
2019	August	2,074	2,520	28
2019	September	1,815	2,283	29
2019	October	2,467	2,122	31
2019	November	2,215	1,914	28
2019	December	2,619	2,261	32



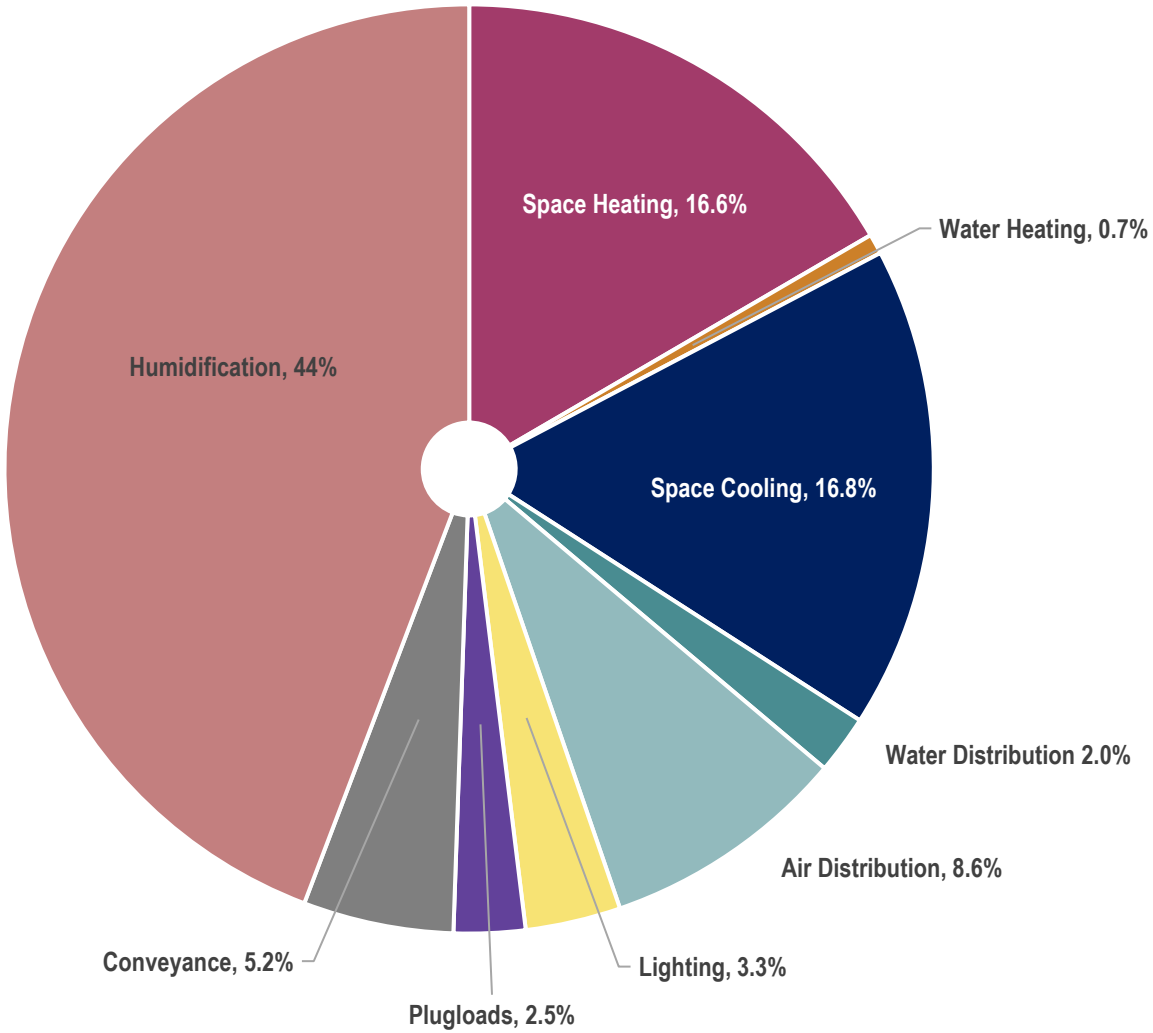
Notes:

1. A regression analysis was utilized to develop a baseline energy model for natural gas uses in the building. Natural gas is utilized for cooking in the museum's café.

2. **Insight:** The analysis shows that MoMA Main's cooking energy profile follows a typical trajectory and is driven by the number of days that the building's restaurant is open and operational.

UTILITY ANALYSIS

Total 2019 Consumption by End Use



End Use	Energy Consumption (kBtu)	% Energy Consumption
Space Heating	28,373,022	16.6%
Water Heating	1,188,774	0.7%
Space Cooling	28,709,029	16.8%
Water Distribution	3,484,022	2.0%
Air Distribution	14,693,900	8.6%
Lighting	5,667,729	3.3%
Plug Loads	4,250,797	2.5%
Conveyance	8,942,825	5.2%
Humidification	75,566,439	44.1%

Notes:

1. The end use categories are based on ASHRAE Standard 211-2018 Guidelines.
2. Equipment runtimes are based on discussions with building staff and standard assumptions, along with a 2020 LL87 report, where applicable.
3. Humidification and space heating end uses require further refinement.

MOMA QNS

MOMA QNS TASK LIST STATUS

Data Collection & Review

- ☑ Minimum 12-Months Pre-COVID Utility Data
- ☑ Existing Building MEP Drawings
- ☑ BMS Sequence of Ops
- ☑ Conduct Preliminary Site Walkthrough
- ☐ Conduct Operator Interviews **(Ongoing)**

Develop Baseline Energy Model

- ☑ Total Annual Energy Use Breakdown by End Use
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Site Survey & Energy Efficient IAQ Recommendations

- ☐ Conduct Detailed Site Visits **(Scheduled)**
- ☐ Develop Filtration and Airside Equipment Operation Log
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Energy Efficient IAQ Energy Analysis

- ☐ ASHRAE Recommendations Energy Model
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Economic Analysis

- ☐ Develop Design Document for Cost Estimator
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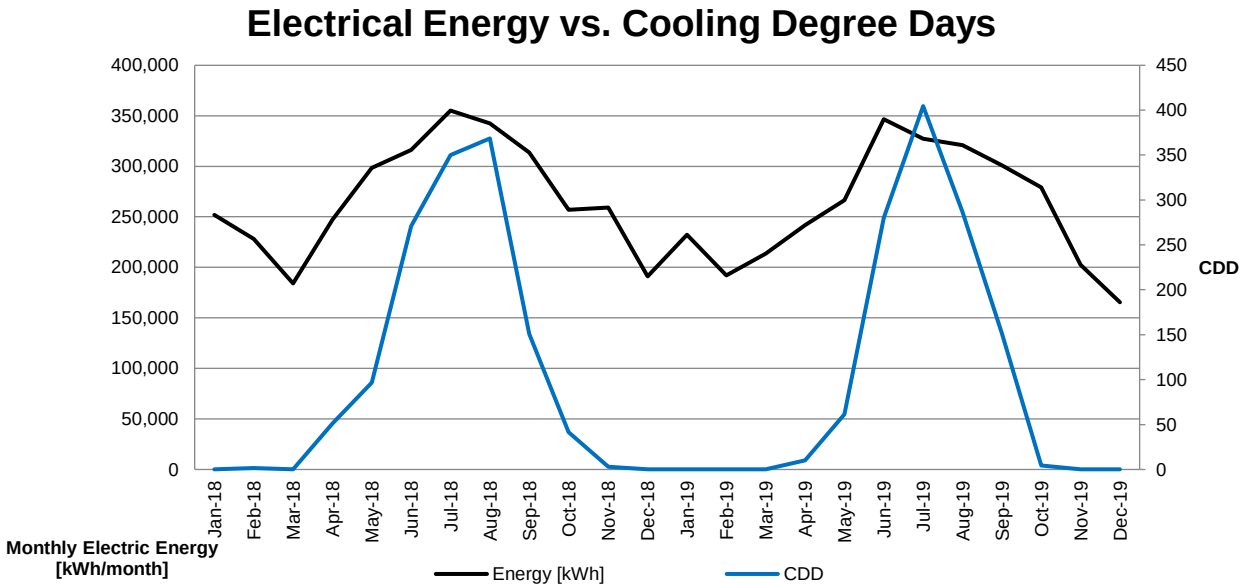
Final Reporting

- ☐ Final Report
- ☐ Case Study Documentation

BASELINE ENERGY MODEL

Electricity

Year	Month	Energy [kWh]	Cost [$]	Days	CDD
2018	January	251,819	39,400	35	0
2018	February	228,000	33,857	29	2
2018	March	184,000	28,334	28	0
2018	April	247,200	38,151	30	51
2018	May	298,400	41,531	29	97
2018	June	316,000	49,349	29	271
2018	July	355,200	53,013	30	350
2018	August	342,400	54,506	29	369
2018	September	313,600	49,646	28	151
2018	October	256,800	36,930	28	42
2018	November	259,200	38,307	33	3
2018	December	190,968	13,626	25	0
2019	January	232,232	30,320	35	0
2019	February	192,000	27,186	29	0
2019	March	213,600	33,480	31	0
2019	April	241,600	33,398	28	10
2019	May	266,400	36,885	29	62
2019	June	346,400	52,940	31	280
2019	July	327,200	73,329	28	405
2019	August	320,800	50,948	29	287
2019	September	300,800	46,510	28	152
2019	October	279,200	41,701	30	5
2019	November	202,400	31,757	31	0
2019	December	165,368	30,571	24	0



Notes:

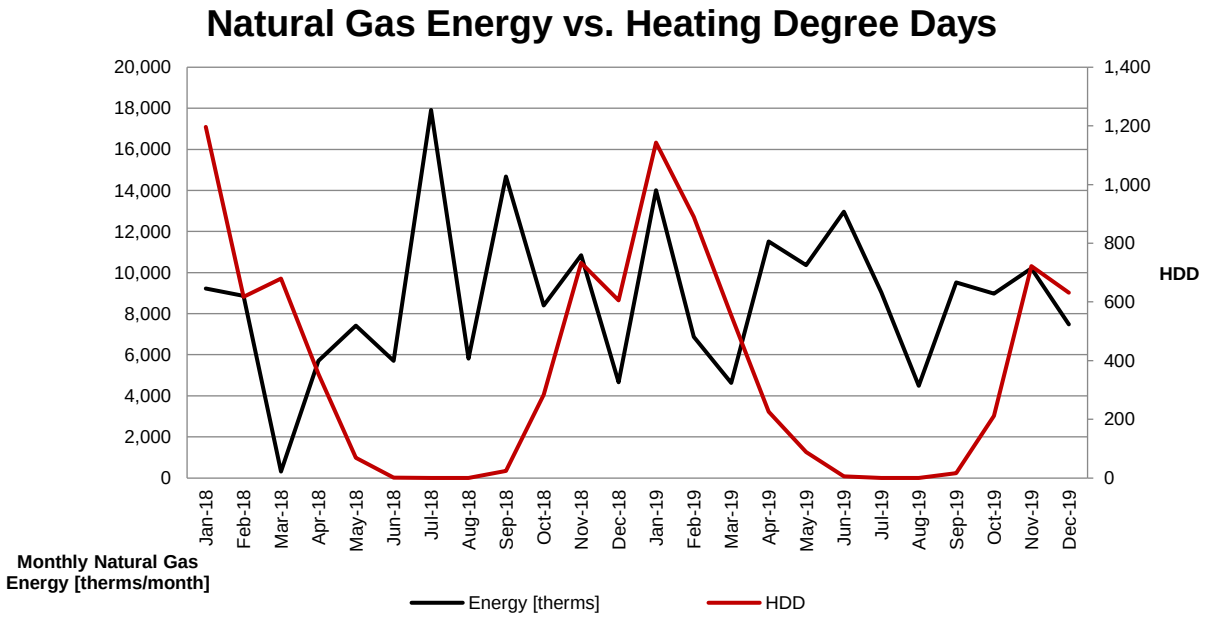
1. A regression analysis was utilized to develop a baseline energy model for cooling end uses in the building.

2. **Insight:** The regression analysis shows that MoMA QNS cooling energy profile is consistent year-round due to the stringent temperature and humidity requirements for Museum gallery and art storage spaces.

BASELINE ENERGY MODEL

Natural Gas

Year	Month	Energy [therms]	Cost [$]	Days	HDD
2018	January	9,219	8,017	36	1,196
2018	February	8,862	8,281	29	617
2018	March	308	355	28	680
2018	April	5,711	5,257	30	355
2018	May	7,421	6,727	29	69
2018	June	5,708	5,325	30	2
2018	July	17,922	13,371	30	0
2018	August	5,814	5,421	29	0
2018	September	14,684	12,447	28	24
2018	October	8,398	7,664	28	284
2018	November	10,850	9,788	33	734
2018	December	4,655	4,428	24	605
2019	January	14,007	15,278	36	1,143
2019	February	6,870	5,415	29	891
2019	March	4,630	3,949	30	554
2019	April	11,515	6,695	28	226
2019	May	10,355	7,749	29	89
2019	June	12,956	9,547	31	5
2019	July	9,039	6,499	28	0
2019	August	4,486	5,117	29	0
2019	September	9,520	7,167	28	16
2019	October	8,973	5,903	30	212
2019	November	10,209	7,766	31	723
2019	December	7,474	6,616	24	631



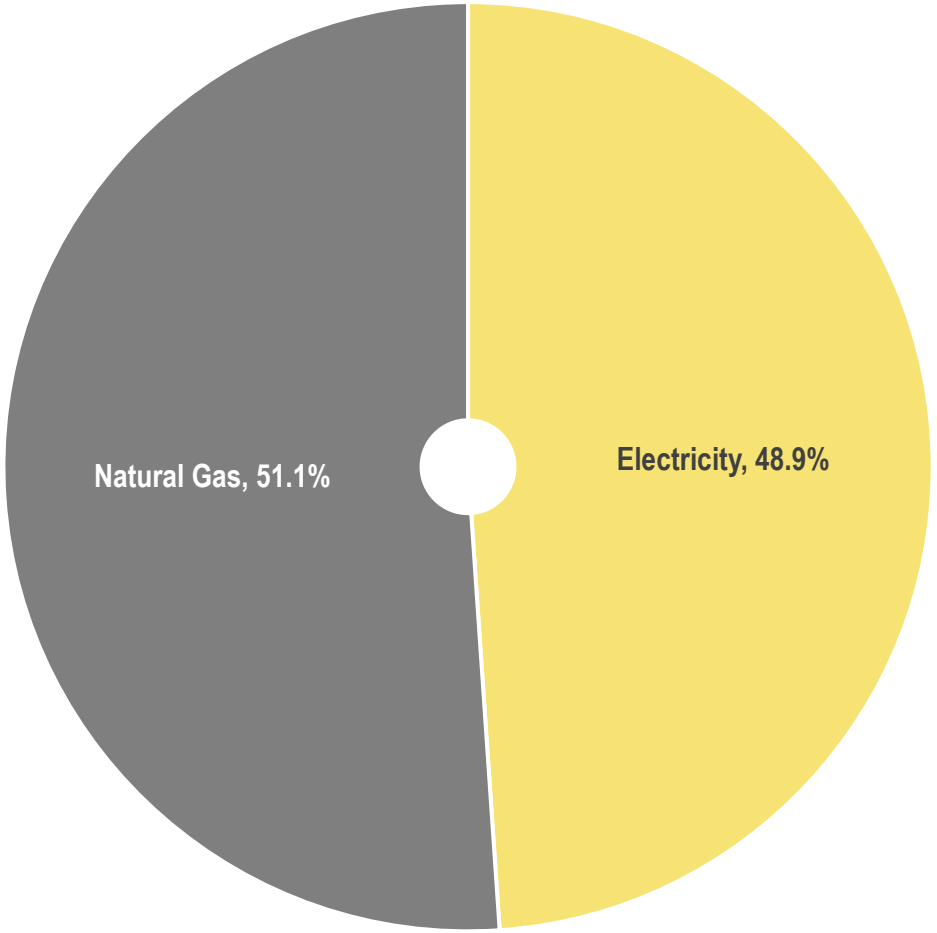
Notes:

1. A regression analysis was utilized to develop a simplified energy model for heating end uses in the building.

2. **Insight:** The regression analysis shows that MoMA QNS's heating energy profile follows a typical trajectory and is driven by outside air temperature. Additional investigation into peaks will be required. May need to run regression analysis based on OA RH instead of OA temp since NG is used to generate steam for humidification and space heating.

BASELINE ENERGY MODEL

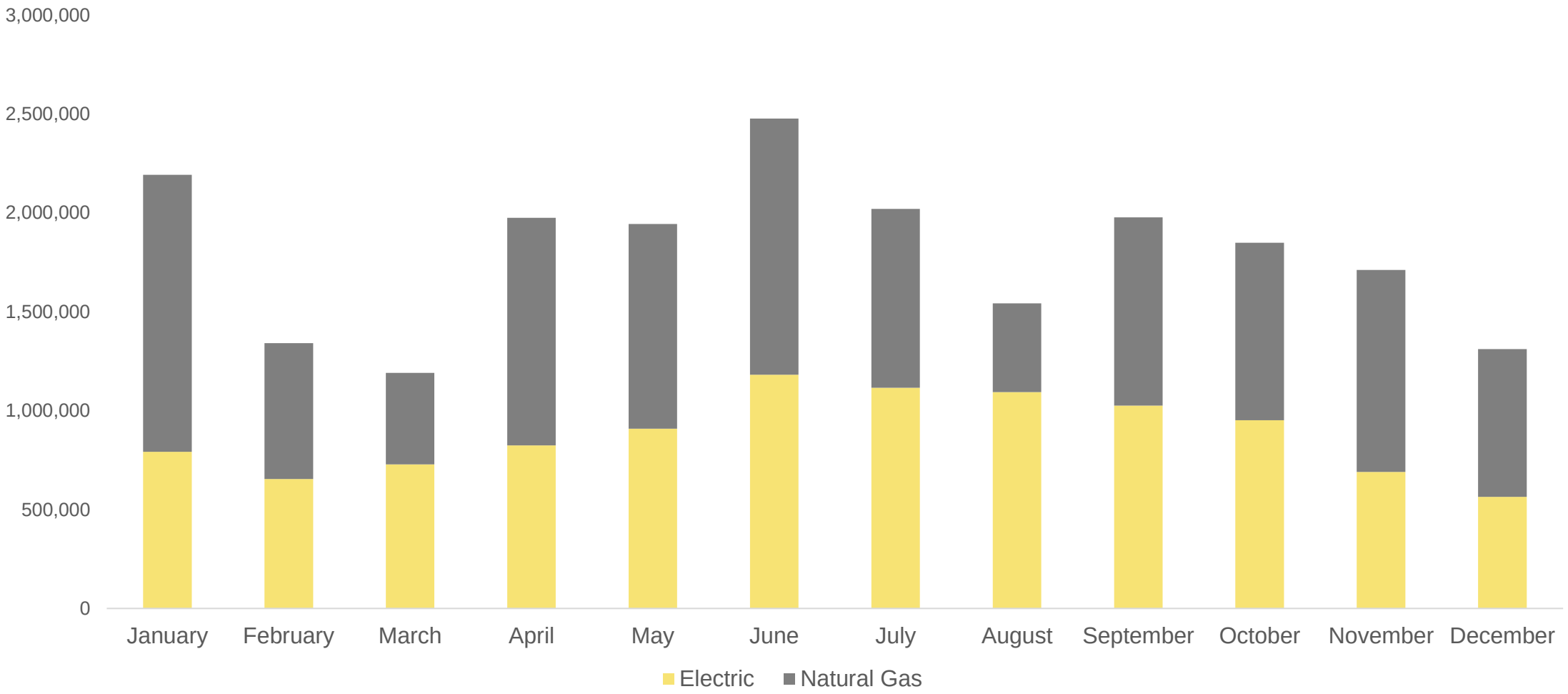
Total Regression Based 2019 Consumption by Utility



Energy Source	Energy Consumption [kBTUs]	% Energy Consumption
Electricity	10,536,256	48.9%
Natural Gas	11,003,594	51.1%

BASELINE ENERGY MODEL

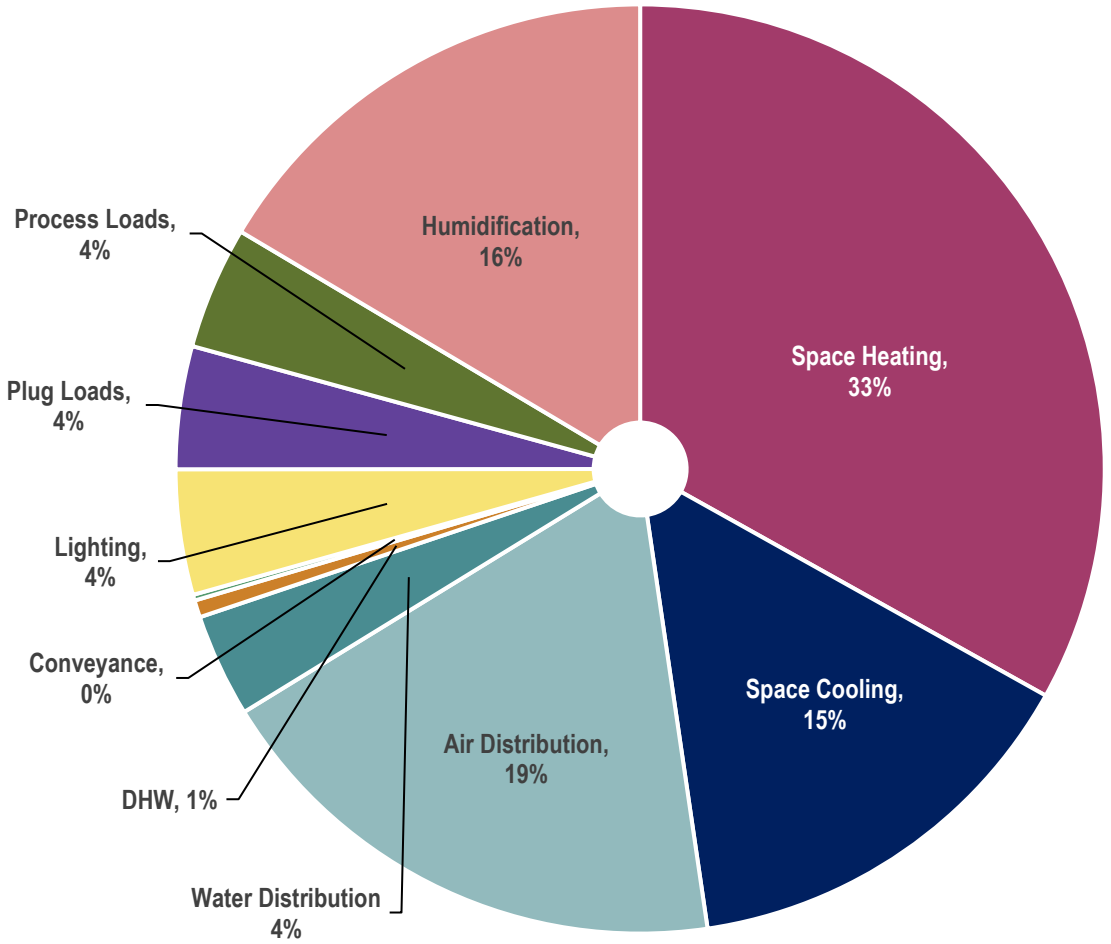
Total Monthly Consumption by Utility [kBtu]



Total 2019 Consumption: 21,539,850 kBtu

UTILITY ANALYSIS

Total 2019 Consumption by End Use



End Use	Energy Consumption (kBtu)	% Energy Consumption
Space Heating	7,376,459	33.2%
Space Cooling	3,246,275	14.6%
Air Distribution	4,134,779	8.6%
Water Distribution	800,678	3.6%
Water Heating	133,000	0.6%
Conveyance	45,000	0.2%
Lighting	971,000	4.4%
Plug Loads	952,000	4.3%
Process Loads	952,000	4.3%
Humidification	3,667,867	16.5%

Notes:

1. The end use categories are based on ASHRAE Standard 211-2018 Guidelines.
2. Equipment runtimes are based on discussions with building staff and standard assumptions, along with a 2020 LL87 report, where applicable.

NOTES, ASSUMPTIONS & RESOURCES

- Resource: ASHRAE Standard 211-2018
- Existing LL87 Reports for both buildings (2018-2019) utilized as a check on JB&B analysis.
- Existing documentation from MoMA Expansion project (JB&B design).
- Energy Star Portfolio for Utility Data (Con Ed benchmarking link enabled).
- Existing schedule sheets utilized for Energy Use Breakdown.

NEXT STEPS

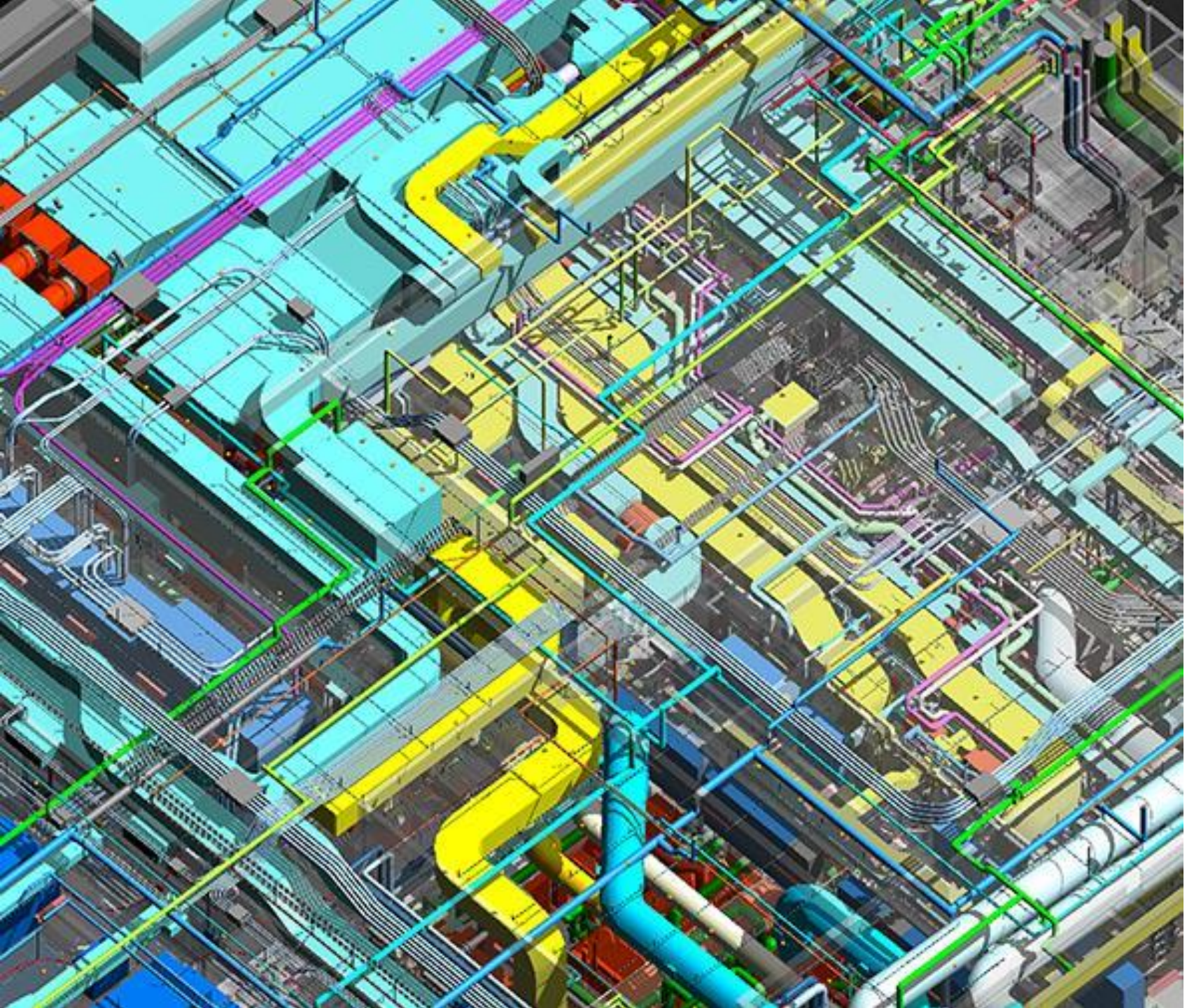
NEXT STEPS

MoMA Projects

- Site visits to collect IAQ info and develop recommendations
- Develop prelim list of ECMs
- Build ASHRAE Recommendations Model

Other Project Sites

- Kick-off meetings with Rudin and Horace Mann staff
- Baseline Energy Models for Rudin properties
  - 80 Pine/3 TSQ calibrated energy model



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