Embodied Carbon Benchmark Study

LCA for Low Carbon Construction

Part One

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The project was developed by the research team: Erin McDade of Architecture 2030, Kathrina Simonen of the University of Washington (UW), Stacy Smedley of Skanska USA, and Larry Strain of Siegel and Strain with input from Jordan Palmeri of Oregon DEQ.

The University of Washington team was comprised of principal investigator Kathrina Simonen, and graduate research assistant Barbara Rodriguez, with key contributions from Stefanie Barrera, Tina Dilegge and Monica Huang.

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Whole Building LCA Datasets

- Arup Embodied Carbon Dataset
- International Living Future Institute
- Kieran Timberlake
- MIT Concrete Sustainability Hub
- MIT DeQo
- UW CLF LCA research
- Skidmore Owings & Merrill (SOM)
- WRAP Embodied Carbon Dataset

Contributions of LCA data

- Adrian Smith + Gordon Gill
- Athena Institute
- CSTB (French HQE research)
- eTool (Australia)
- Magnusson Klemencic Associates (MKA)
- Quantus
- Seigel and Strain
- Skanska USA
- Thornton Tomasetti
- University of British Columbia/ Rob Sianchuk
- Walter P. Moore & Associates

Published LCA Studies

- Council on Tall Buildings and Urban Habitat: Tall Building LCA Study
- Athena: Environmental Building Declarations

EXECUTIVE SUMMARY

The Embodied Carbon Benchmark Study provides data to building industry professionals integrating embodied carbon into life cycle decision making. However, in order to allow embodied carbon results to be comparable across projects and practices, a common standard for life cycle analysis is required. The next stage of this project will result in the creation of such an environmental life cycle assessment (LCA) practice guide (due December 2017).

This report outlines the first stage of the project, which establishes reasonable estimates of the embodied carbon of buildings (the greenhouse gas emissions resulting from extracting, manufacturing and installing materials and products over the life cycle of a building) and characterizes the level and sources of uncertainty in our current knowledge.

The largest known database of building embodied carbon was created, containing over one thousand buildings. Information on building parameters (such as area, number of stories etc.), the LCA methodology used to assess the building (such as included life cycle stages and LCA data sources) and the resulting embodied carbon (reported in units of $kgCO2_e/m^2$) were compiled. The database is presented in Appendix A and online with a data visualization tool at (http://www.carbonleadershipforum.org/data-visualization/) to enable users to evaluate and sort the data.

The research team identified four main findings and limitations, which are detailed below. A survey of the Advisory Committee confirmed strong support for the findings. Over 85% of participants responded as highly confident or confident with regards to Findings A and B and over 70% of the participants responded as highly confident or confident with regards to Findings C and D.

Finding A: The data presented in the RESEARCH database represents a reasonable order of magnitude and range of variation of estimates of the embodied carbon footprint of buildings.
Finding B: The initial embodied carbon (LCA stage A) of a building's structure, foundation and enclosure is typically less than 1,000 $kgCO2_e/m^2$.
Finding C: The initial embodied carbon (LCA stage A) of low-rise (less than 7 story) residential building's structure, foundation and enclosure is typically less than 500 $kgCO2_e/m^2$ however there is not sufficient data to state ranges with confidence.
Finding D: For commercial office buildings, the range of initial embodied carbon (LCA stage A) for building structure, foundation and enclosure is between 200 and 500 kg $CO2_e/m^2$ for 50% of buildings in the database.

The primary limitations of the above findings are that (1) the database only includes initial embodied carbon of primary building components, (2) the analysis methods used to

generate the data were not aligned, making it difficult to directly compare buildings from different sources of data, and (3) the database is not a statistically representative sample of current building practices. The research team, in consultation with the Advisory Committee, identified sources of uncertainty and strategies to overcome the uncertainty in estimating the embodied carbon of buildings.

Sixteen projects were identified to integrate strategies aimed at overcoming the identified sources of uncertainty, highlighting future research projects and research needs. The Advisory Committee survey prioritized the projects and identified two as 'essential': (P1) LCA Practice Guide (funded as the second stage of this research project) and (L3) Material Quantity Reporting.

All other proposed research/resource needs were rated as 'valuable' to individual practitioners and the industry as a whole. A list of research projects prioritized by collective average ranking of the Advisory Committee based on value to the industry as a whole is shown below (highest priority first). More detailed project descriptions are included in Section 5 of this report.

Ranked List of Research Projects/Resource Needs

P1: LCA Practice Guide
L4: Material Quantity Reporting
P4: Define Reference/Benchmark Building
P3: Building Industry Dataset (aligned/open source)
P2: LCA Baseline Building Guidance (LEED v4)
G3: Office Building Benchmarks
L1: Standardized Building Models
G2: National Industry Implications
G1: Re-use/Retrofit/New
L3: Data/Tool Comparison
L6: Evaluating the Known Unknowns of Building LCA
L8: Regional Variation
P5: Lifespan Standardization
L2: Housing LCA
L7: Evaluating Subgrade Construction, Parking and Foundations
L5: Building Scale/Construction Trends

Findings of this research will be used to inform the development of the LCA Practice Guide, the next stage of this project, and can be used to identify and develop future research projects and resource needs of value to the building industry as we look to integrate embodied carbon into life cycle decision-making.

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Appendices

1 PROJECT OVERVIEW

This report on the Embodied Carbon Benchmark Study is the first stage of a two-stage project designed to provide guidance to industry professionals looking to integrate carbon into life cycle based decision making. The goals of the study are 1) to establish embodied carbon benchmarks for buildings, and 2) create an environmental life cycle assessment (LCA) practice guide.

The main purpose of this project is to establish reasonable estimates of the typical embodied carbon of building construction and characterize the level and sources of uncertainty in our current knowledge. The project identifies pathways and strategies to reduce uncertainties, which will enable the development of more representative embodied carbon benchmarks in the future.

The project brings together experts in LCA and buildings to identify areas of consensus and disagreement related to estimating building embodied carbon. The Embodied Carbon Benchmark project has five components:

- Convene Advisory Committee,
- Develop framework model,
- Compile and analyze data,
- Identify sources of uncertainty, and
- Publish and disseminate results.

A primary objective of this project is to collect existing whole building LCA studies and compile the embodied carbon results (in kgCO2e, also known as greenhouse gas (GHG) emissions) into a database of both real and theoretical buildings that enables sorting based on relevant parameters such as building scale, use, and location. The research database is described in Section 3.1 of this report and published as Appendix A. The data is sorted and analyzed in Section 3.3.

An Advisory Committee was convened that includes representatives from nine building industry organizations with expertise in LCA, five green building non-governmental organizations (NGOs), seven organizations that offer LCA services and/or develop LCA tools, two government representatives, and three academics. The committee includes representation from the U.S., Canada, Europe, and Australia. Committee members are listed in the Acknowledgements/Participation section at the beginning of this report.

The committee gave input into the formulation of the project, donated data and provided comments on report drafts. The committee also provided input regarding their level of confidence with the presented findings and ranked proposed projects via a survey that is summarized in this report and reported in detail in Appendix F.

2 METHODOLOGY

This project compiled the embodied carbon results from over 1,000 building LCA studies. Building embodied carbon in the buildings was normalized per unit floor area with units of $kgCO2e/m^2$. For more detailed information on the methodology, see Appendix B.

The building industry has developed only few efforts to benchmark embodied carbon in buildings. Some of these include the Athena Report for Incorporating Whole Building LCA Benchmarks into the IE4B, the European SuPerBuildings Project, the Australian Materials and Buildings Products Life Cycle Inventory Database, and the French "Construisons Ensemble HQE Performance."

The data in this study is limited to the embodied carbon databases available to the research team and to the LCA studies that could be read and compiled within the time limitations of the research project (summer and fall of 2016). The data is from non-aligned LCA studies that used different building scopes, different LCA data, and different LCA methods.

Tables 1 & 2 list the parameters used in the final database, and Table 3 lists additional recommended parameters. The database parameters have been categorized as 'building' parameters (those that relate to descriptions of the building) and 'LCA' parameters (those that relate to the goal, scope, and methods of the LCA). Additionally, the data presented in the research database is simplified into general categories (such as ranges rather than specific floor areas) to ensure that individual data points could not be linked to a specific building, providing additional confidentiality. This confidentiality was a requirement of some organizations to submit data.

Table 1: Research Database Building Characteristics Parameters

Parameter	Name	Variables/Units	Notes
BLDG_PUBID	Public ID	Numeric Code	To enable sorting. Source not publicly identified.
BLDG_TYP	Building Type	Commercial / Residential	
BLDG_US	Use	Per CBECS	Aligned with Commercial Building Energy Consumption Survey
BLDG_YEAR	Year	Year range	Year of construction.
BLDG_LOC_REGION	Location	Region	City and Country removed for public data
BLDG_NEW_REN	Construction	New / Renovation	
$BLDG_AREA_M2	Internal Area	Square meter	Area stepped to align with CBECS and for confidentiality
$BLDG_STOR_A	Stories	Stories above grade	No detail over 25 stories for confidentiality

Table 2: LCA Parameters

Parameter	Name	Variables/Units	Notes
LCA_YEAR	Date	Year	When the study was performed
LCA_REFPERIOD	Time	Years	Reference study period/building life
LCA_SOUR_CODE	LCI	Dataset	Grouped but not identified for confidentiality
LCA_STAGES	LCA Stages	A, B, C, D	A = Cradle through construction, B = Use, C = End of Life D= Outside System Boundary
LCA_BLDG_SCOPE	Scope	S, F, E, I	S = Structure, F = Foundation, E = Enclosure, I = Interior
LCA_MAT_Q	Material	Yes or No	Did study report material quantities?
EC_LCAA_PERM2	Result	CO2e/m2	LCA Stage A (A1-A3 or A1-A5)
EC_WB_EX_OPER	Result	tCO2e	Total tons (1000 kg) of CO2e from all studied LCA stages

Table 3: Additional Desired Building and LCA Parameters

Parameter	Name	Variables/Units	Notes
BLDG_HAZ_SEIS	Seismic Hazard	Seismic Zone	
BLDG_HAZ_WIND	Wind Hazard	High Wind	
BLDG_CLIM_ZN	Climate Zone	Per CBECS	
LCA_MAT_Q	Material Quantities		Would like a report of the quantities of materials
Biogenic	Biogenic Carbon	Y/N	Not always clear if biogenic carbon included
Results	Embodied Carbon	$CO2_e/m^2$	Detailed breakdown per LCA stage
Energy	Energy	GJ/m^2	Report Embodied Energy as well

3 RESULTS

3.1 Database Description

The research database has over 1,000 entries describing the embodied carbon of buildings ranging in scale from single-family homes to super-tall high-rise towers located throughout the world. It includes significant data donated by structural engineering firms Arup, SOM and Thornton Tomasetti, additional data from the International Living Future Institute, The DeQo (De Wolf et al. 2016) Database/MIT and the WRAP Database, as well as data compiled by the UW team from a range of data sources. A summary of the database statistics is included in Appendix C.

3.2 Summary Plots

The data was sorted based upon LCA scope, building use, and stories. Figure 1 presents the embodied carbon per square meter for all of the collected data, categorized by Building Use Type and color-coded by LCA building scope. Figure 2 presents the embodied carbon per square meter of office buildings separated by building scope and color-coded by data source (not named to protect confidentiality), and Figure 3 presents the embodied carbon per square meter of residential buildings sorted by number of stories. These graphs were selected by the research team as they represent building types of specific interest to the Advisory Committee. Additional sorting schemes can be made via the data visualization website (http://www.carbonleadershipforum.org/data-visualization/).

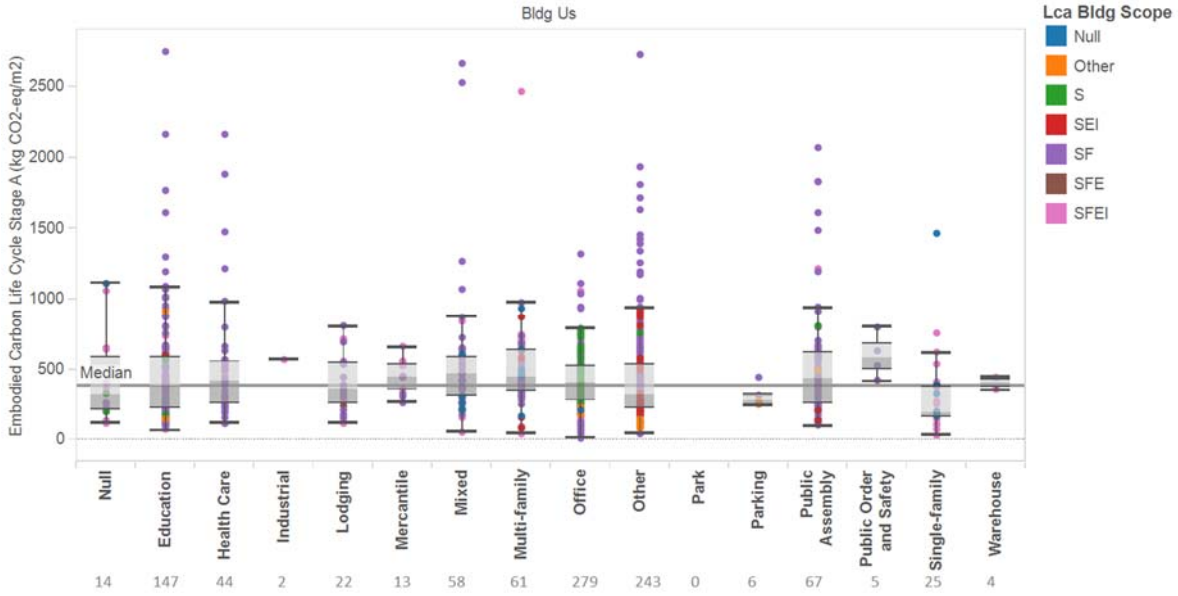

Figure 1: Embodied Carbon per m², no removal of outliers (1,007 buildings)
(S=Structure, SEI=Structure/Enclosure/Interior, SF=Structure/Foundation, SFE=Structure/Foundation/Enclosure, SFEI=Structure/Foundation/Enclosure/Interiors)

NOTE: 54 observations have value greater than 1,000: 953 observations have value below 1,000 kgCO2e/m2.

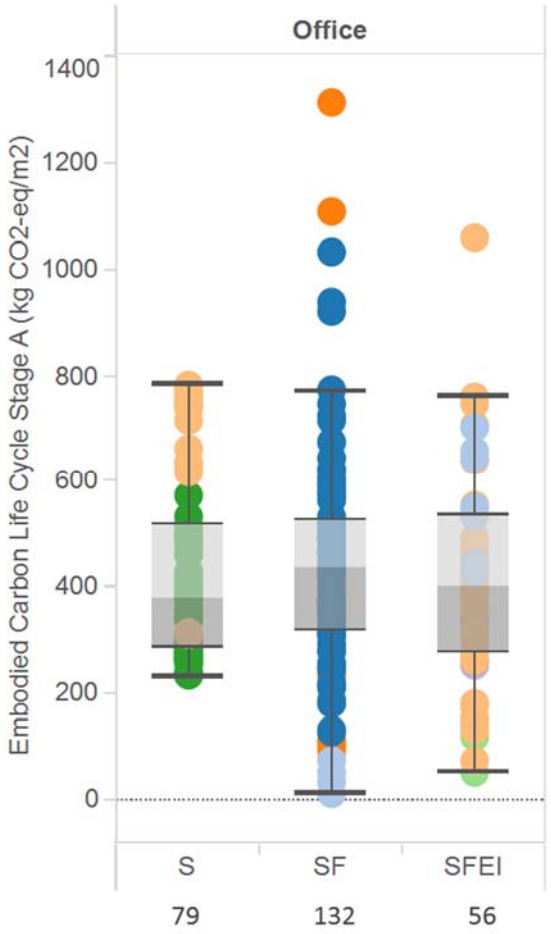

Figure 2: Embodied Carbon per m² of Office Buildings
Color = Database source (not identified for confidentiality purposes)
(S=Structure, SF=Structure/Foundation, SFE=Structure/Foundation/Enclosure, SFEI=Structure/Foundation/Enclosure/Interiors)

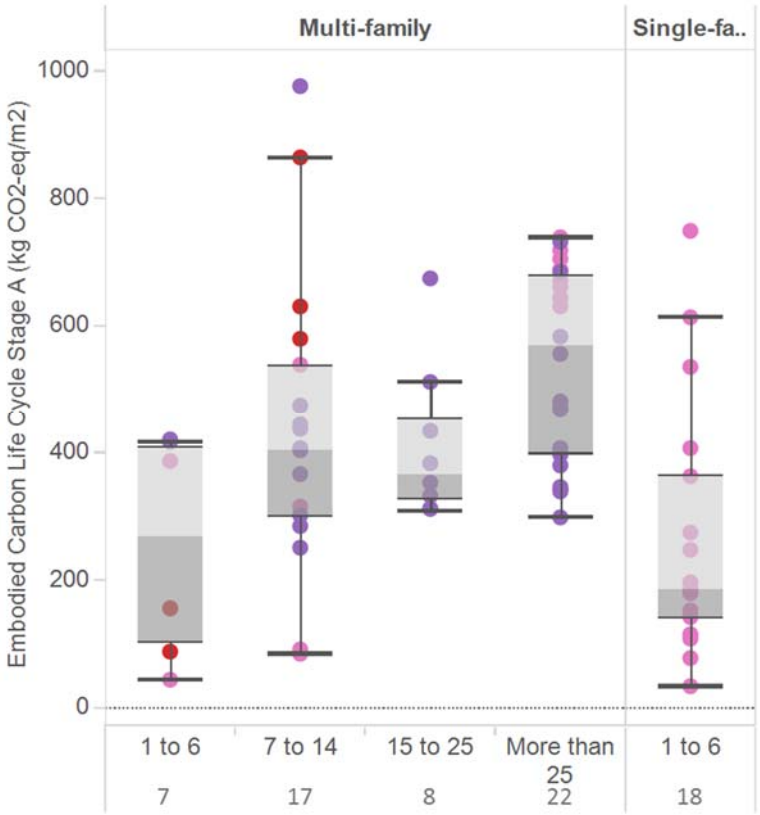

Figure 3: Embodied Carbon per m², of Residential Buildings
(S=Structure, SEI=Structure/Enclosure/Interior, SF=Structure/Foundation, SFE=Structure/Foundation/Enclosure, SFEI=Structure/Foundation/Enclosure/Interiors)

3.3 Data Analysis

The database contains 1,191 'observations' or embodied carbon study results. Of these observations, 26 are renovations, 836 are specified as 'new' and 427 are not specified and assumed to be new. Office buildings are the most populated commercial building type, (362), followed by 'Education' (183) and 'Other' (144). There are 136 uncategorized residential buildings (which we believe are multi-family), 76 entries categorized as multi-family and 26 single-family residential entries.

Over 50% of the entries are for buildings in North America, with the remainder predominantly in Asia/Pacific or Europe or not stated. See Appendices C & D for more detail about the data.

The value of this database lies in the large number of buildings LCA records available for all scopes and different life cycle stages. However the data aggregation from different subsets is not conducive to a consistent dataset such as the one required for statistical inference. Common errors include data-entry mistakes, omissions, transpositions (where correct entries are located under wrong dataset variables), or variations in interpretation of data. For instance, from the subgroup of buildings reporting Embodied Carbon Life Cycle Stage A (EC_LCAA_M2) some sources consider Stage A only as manufacturing while other sources consider construction activities as well (A1-A5). An inconsistent dataset presents obvious challenges to useful inferences and thus can distort the identification of statistical patterns, essential for benchmark studies.

Another important concern arising from this analysis is the representativeness of the data for a regional or a specific building sample defined by use or type. The data presented through the ECD comes from case studies where the data was available. However these are not representative of the full building market. In sum, the following conclusion can be presented from this analysis:

- There is an urgent need to standardize general building design data and building life cycle assessment data. Alignment in definitions of building area (gross, internal or exterior), building life cycle stages and scopes are critical for comparison.
- Further research is needed to develop larger samples that represent the actual commercial and residential building stock.

4 DISCUSSION

4.1 Limitations

The inherent limitations of the Embodied Carbon Benchmark Database should be acknowledged in all publications of the data, including the website. A summary of the key limitations are as follows:

1. The database reports initial embodied carbon of buildings and does not include maintenance, energy use, or end of life impacts, nor building related components such as site work, mechanical/electrical systems and furnishings.
2. It is not appropriate to use this data to make comparative assertions between building types or categories.
3. This database is not a statistically representative sample of current building practices and is weighted to larger, more prominent buildings than those that make up the complete building stock.

4.2 Sources of Uncertainty

The data contains significant variability. In the process of compiling and analyzing the data, the sources of uncertainty were organized into categories A through F and sub-numbered by the letter. Table 4 describes the source of uncertainty, and Table 5 presents strategies to address the uncertainty. Table 6 and 7, which are in Section 5, proposes research projects (categorized P, L, and G) that would address these sources of uncertainty using the proposed strategies, and provides the option of ranking the possible projects based on importance and priority.

Table 4: Uncertainty Categories and Details

Uncertainty Category	Uncertainty Details
A. LCI Data	Life Cycle Inventory Datasets: not aligned nor developed consistently. 1. Different software/LCI sources were used. 2. Different assumptions were made regarding manufacturing methods transportation etc. 3. Only carbon was tracked-other environmental impacts (e.g. smog, acidification etc.) should be addressed and tracked 4. Results were taken from different users at different times resulting in different interpretations and data sources that are not comparable.
B. LCA Method	LCA Methodology: not aligned. 1. Different LCA scope life cycle stages and calculation methodologies were used. 2. Methodologies for treatment of biogenic carbon and recycling were inconsistent.
C. Building Scope	Building Scope: not aligned. 1. Extent of building modeled was not consistent or comprehensive. 2. It is uncertain if models were sufficiently detailed (typically missing scope such as site work, MEP systems and furnishings). 3. Assumptions regarding component lifespan & maintenance were inconsistent.
D. Inconsistent Meta Data	Insufficient information collected to classify/compare buildings 1. Building descriptions were not consistently reported. No standardization. 2. Occupants as a benchmark metric may represent function better than area. 3. Construction type/fire rating may be more relevant to track than use 4. Residential building categories need refinement to reflect different typologies. 5. Regional variation was not included (climate, soil type, hazard zone)
E. Insufficient Data	LCA data lacking to enable comparisons and/or make decisions. 1. Small scale residential and commercial projects as well as renovation and retrofits were under-represented. 2. Data was not a statistically representative sample of the existing building stock. 3. Uncertain if data can be generalized to make planning/policy decisions.

4.3 Reducing Uncertainty/Future Research & Standardization Needs

Table 5: Strategies to overcome uncertainty outlined in Table 4.

Uncertainty Source	Strategies to overcome uncertainty
A. LCI Data	1. Develop North American LCA dataset for building industry integrating Environmental Product Declaration (EPD) results (as done in France). 2. Develop case studies of similar buildings using different tools/data to assess significance of tool/data differences. 3. Refine level of detail of LCA impacts (track more than carbon). 4. Standardize method to report materials quantities enabling LCI data to evolve over time and enable consistent comparisons.
B. LCA Method	1. Develop LCA Practice Guide (Pankow funded) 2. Build consensus/define method for tracking/reporting biogenic carbon/recycling (LCA Practice Guide?). 3. Define a reference building; green building rating systems reward improvement over a 'reference building', however little guidance exists on how to define a reference building exists.
C. Building Scope	1. Develop LCA Practice Guide (Pankow funded) 2. Determine impact of scope (site work, MEP, furnishings etc.) not currently included in LCAs. 3. Evaluate current building practices for material and component lifespan and develop standardized assumptions for building/component lifespan.
D. Inconsistent Meta Data	1. Develop consensus on building and LCA parameters to report. (LCA Practice Guide?) 2. Track/report building occupants in LCA to enable future research exploring assessment per person rather than per area. 3. Track construction type and fire rating in LCA to enable future research to categorize evaluate on this metric. 4. Track climate, hazard, and soil conditions to enable future research to evaluate relative impacts. 5. Develop LCA studies of different housing types to evaluate how best to categorize housing typologies.
E. Insufficient Data	1. Develop additional case studies: a. Expand types of buildings studied (residential, renovation/retrofits, etc.). b. Develop models to estimate the range of environmental impacts for enclosure and interiors to complement existing data on office building structure. c. Collect additional data on material quantities to enable more robust benchmarking (MIT DeQo/Athena/CLF SE 2050).

	2. Develop a statistically representative sample of buildings using aligned LCA data and methodology. 3. Analyze and extend results of database with additional LCA studies in order to help inform policy decisions.

5 RECOMMENDATIONS

The research team proposed findings, limitations, and research needs and solicited feedback from the Advisory Committee via survey. See Appendix F for more details of the survey. Of note, one of the objectives of this project was to help understand level of consensus on these topics and highlight areas of disagreement. Therefore, the level of support by Advisory Committee members is characterized for each recommendation.

5.1 Embodied Carbon Benchmarks

The Advisory Committee met in September to discuss the conclusions that could be made based upon the preliminary data presented at that time. Subsequently, the dataset was cleaned (removing duplicates and identified outliers) and evaluated for correlation between parameters. The general recommendations were discussed and refined with the Advisory Committee are presented in Table 6.

Table 6: Research Findings

Finding A: The data presented in the research database represents a reasonable order of magnitude and range of variation of estimates of the embodied carbon footprint of buildings.
Finding B: The initial embodied carbon (LCA stage A) of a building's structure, foundation and enclosure is typically less than 1,000 kg$CO2_e/m^2$.
Finding C: The initial embodied carbon (LCA stage A) of low-rise (less than 7 story) residential building's structure, foundation and enclosure is typically less than 500 kg$CO2_e/m^2$ however there is not sufficient data to state ranges with confidence.
Finding D: For commercial office buildings, the range of initial embodied carbon (LCA stage A) for building structure, foundation and enclosure is between 200 and 500 kg $CO2_e/m^2$ for 50% of buildings in the database.

The limitations evaluated by the advisory committee are reproduced from Section 4.1 as follows:

1. The database reports initial embodied carbon of buildings and does not include maintenance, energy use or end of life impacts nor building related components such as site work, mechanical/electrical systems and furnishings.

2. It is not appropriate to use this data to make comparative assertions between building types or categories.
3. This database is not a statistically representative sample of current building practices and is weighted to larger, more prominent buildings than those that make up the complete building stock.

Participants were asked in the survey to assess their level of confidence with the following statements acknowledging the limitations noted in the report draft. Figure 4 represents the number of responses for each assessment of the Findings.

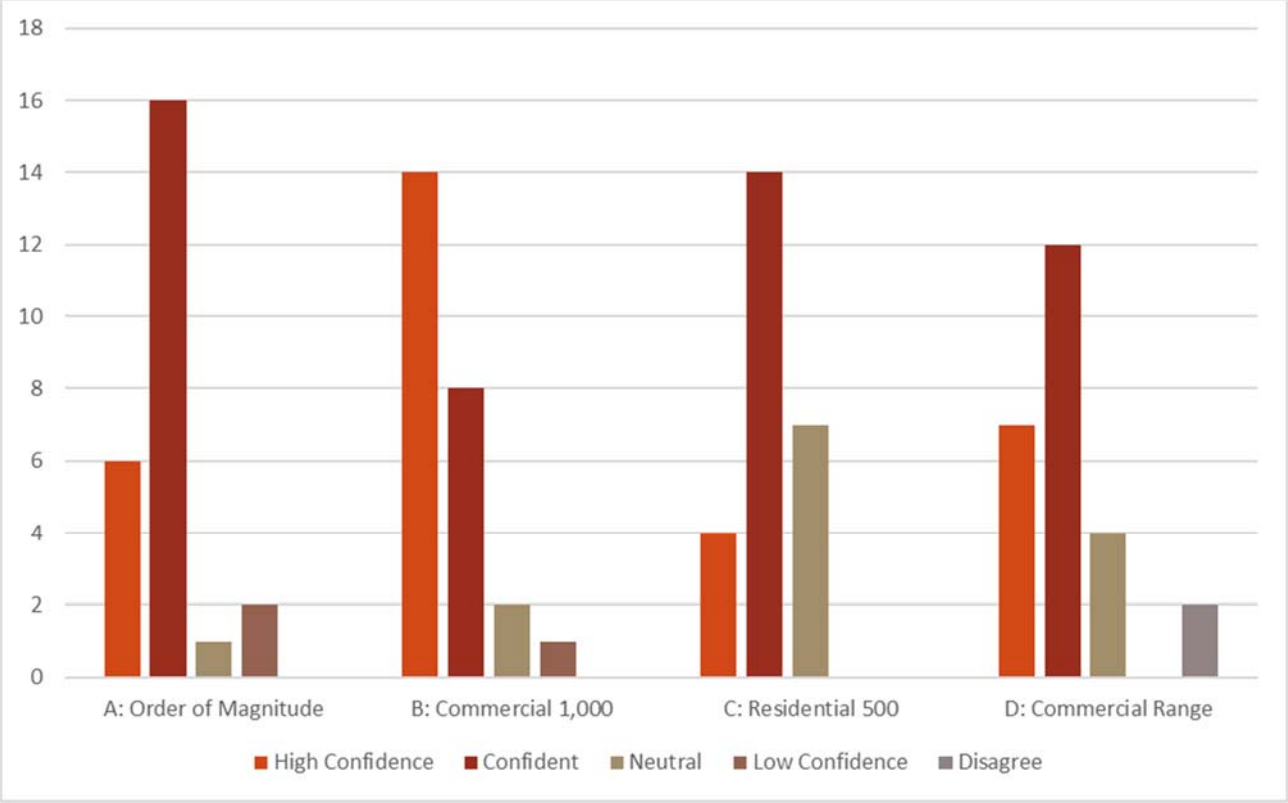

Figure 4: Advisory Committee Survey Results
"Asses level of confidence with the statements (in Table 6) acknowledging the limitations noted."

Of note, over 85% of the participants are confident or highly confident in findings A and B and over 70% of the participants are confident or highly confident in findings C and D.

5.2 Research/Resource Needs

The following is a summary of potential projects that integrate strategies to overcome the identified sources of uncertainty with fields to assess the importance of the research need. Participants were asked to rank the findings in level of **value to the building industry as a whole** according to these criteria:

- 5=Critical (must be done first to enable future research)
- 4=Essential (data/tools needed now and valuable to a wide audience)
- 3=Valuable (worth doing after more essential work is complete)
- 2=Neutral (not sufficiently useful to prioritize)
- 1=Not Important (low perceived benefit)

Additionally, participants were asked to rank the top three projects that would be most valuable to enabling **their LCA practice and/or their use of LCA data in practice.** Commentary on why they selected these projects is included in Appendix F.

Table 7: Projects to Address Uncertainty

Importance 5=Critical 4=Essential 3=Valuable 2=Neutral 1=Not Important					**Average Importance**	Project Name (Known Initiatives) [Strategies Addressed]	Priority Ranking (# votes)		
5	**4**	**3**	**2**	**1**		**STANDARDIZING PRACTICE**	**1**	**2**	**3**
12	12	2	0	0	**4.4**	P1: LCA Practice Guide (funded by Pankow) *Develop guidance on LCA methods, building scopes, building parameters and reporting methods to help enable collection of more aligned data. Work with advisory committee and consider existing and emerging standardization efforts and work to harmonize.* [B1, B2, C1, D1, A3] perhaps [D2, D3, D4]	6	7	3
4	14	8	0	0	**3.8**	P2: LCA Baseline Building Guidance (LEED v4): *Provide specific LEED v4 guidance on how to define an appropriate baseline building.* [B3 & perhaps C3]	0	5	5

7	8	10	0	0	**3.9**	P3: Building Industry LCA Dataset (aligned/open source) *Develop consistent dataset of LCA impacts of building products, transportation and energy use for use by all North American LCA tool providers. Align with and develop mechanism for aligning EPDs. (Note, this is done in France).* [A1]	4	3	4
7	11	6	2	0	**3.9**	P4: Define Reference/Benchmark Building *Enable Comparisons & use effectively in rating systems schemes.* [B3]	2	6	3
1	8	14	3	0	**3.3**	P5: Lifespan Standardization: *Research component and building lifespan and develop standardized guidance.* [C3]	0	0	0
						GENERATING LCA DATA			
7	8	8	3	0	**3.7**	L1: Standardized Building Models: *Develop a statistically representative sample of whole-building LCA results using aligned LCA data and methodology. Ensure database for benchmarks represents typical building construction (not all low carbon or unique structures)* [E2, A3, E1a]	0	1	2
2	5	16	3	0	**3.2**	L2: Housing LCA: *Study LCA impacts of range of housing types to increase understanding of impacts and recommend methods to categorize.* [E1a, D5, A3]	0	0	1
2	11	12	0	0	**3.6**	L3: Data/Tool Comparison: *Generate case studies in order to evaluate the impact of different users, data and tools.* [A2, A3]	0	1	1

10	11	5	0	0	**4.2**	L4: Material Quantity Reporting: *Establish Mechanism/Motivation to Track and Report Building Material Quantities (MIT/deQO/Athena/CLF SE 2050)* [A4, E1c]	3	2	3
1	5	14	5	0	**3.1**	L5: Building Scale/Construction Trends: *Evaluate data/generate data to evaluate trends (e.g. building height, area, structural system and below 0grade construction) in order to make generalizable recommendations.* [E3]	1	0	0
4	7	12	2	0	**3.5**	L6: Evaluate the Known Unknowns of Building LCA *Research to identify the environmental impact of building components not typically included in LCA: MEP system, furnishings, site work etc.* [C2]	0	0	1
1	6	15	4	0	**3.2**	L7: Evaluate Subgrade Construction, Parking and Foundations *Generate more data and establish methodology to account for subgrade parking and foundation impacts in order to establish appropriate benchmarks for generalized comparisons.* [B3, E2]	0	0	1
3	6	14	3	0	**3.3**	L8: Regional Variation *Develop data and methodology to account for regional variation such as climate/energy code and seismic hazard/seismic performance criteria.* [B3, D3, D4]	0	0	0

						DEVELOPING GUIDANCE			
2	12	12	0	0	**3.6**	G1: Re-Use/Retrofit/New: *Connect additional studies related to re-use and retrofit to data on new building construction to inform policy decision-making at a city scale.* [E3]	2	0	0
4	13	6	3	0	**3.7**	G2: National Industry Implications: *Evaluate findings relative to national sector emissions estimates and current and future building projections.* [E3]	0	1	0
5	12	8	1	0	**3.8**	G3: Office Building Benchmarks *Expand office building structural data with LCA studies of facades to enable more precise generalizable information on office building benchmarks.* [E1b]	1	0	1

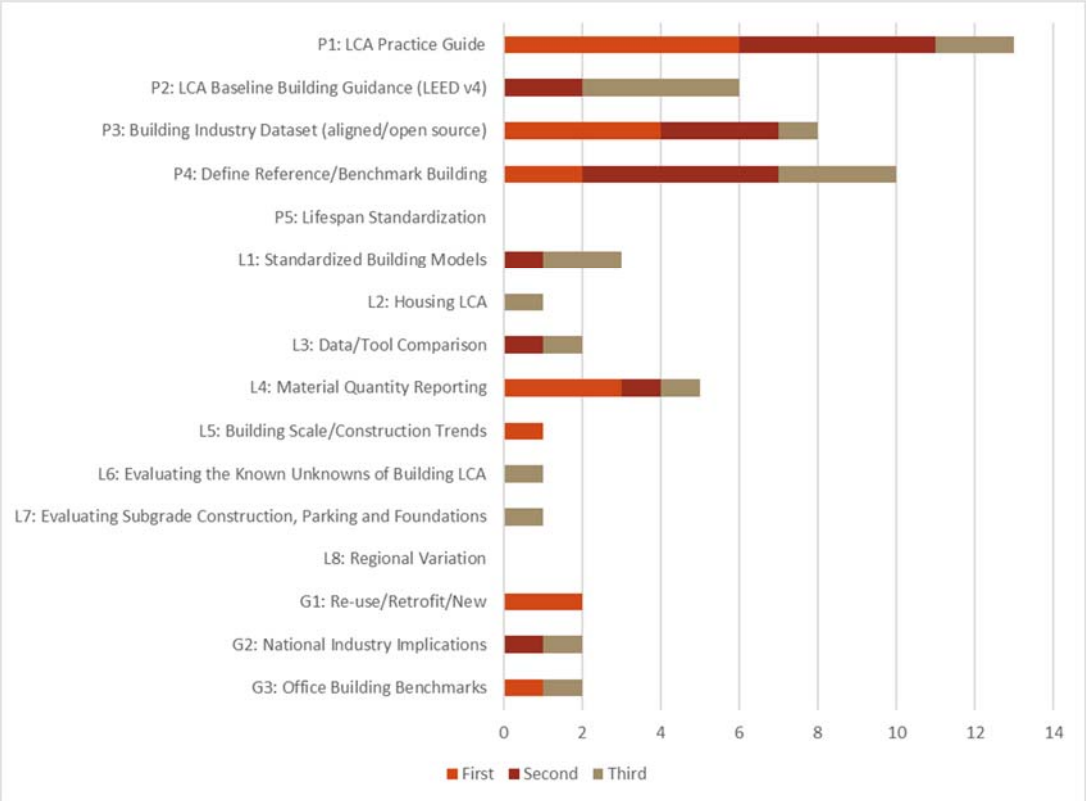

Figure 5: Advisory Committee Survey Results: 'Rank the top three project that would be most valuable to enabling their LCA practice and/or use of LCA data in practice.'

Figure 5 summarizes the cumulative survey findings identifying which three projects the Advisory Committee members found to be the most valuable to their LCA Practice. Of note, projects focused on standardizing practice (P1-P4) are the top four projects identified.

Sorting the projects from most to least critical in the survey results in table 8 which reports the collective average ranking of value to the building industry as a whole. Of note, two projects: development of an LCA Practice Guide and L4: Material Quantity Reporting are collectively identified as 'Essential' and all projects are considered 'Valuable'.

Table 8: Collective Ranking of Value to Industry as a Whole

Collective Ranking	Project Title (See Table 7 for Project Descriptions)
4.4	P1: LCA Practice Guide
4.2	L4: Material Quantity Reporting
3.9	P4: Define Reference/Benchmark Building
3.9	P3: Building Industry Dataset (aligned/open source)
3.8	P2: LCA Baseline Building Guidance (LEED v4)
3.8	G3: Office Building Benchmarks
3.7	L1: Standardized Building Models
3.7	G2: National Industry Implications
3.6	G1: Re-use/Retrofit/New
3.6	L3: Data/Tool Comparison
3.5	L6: Evaluating the Known Unknowns of Building LCA
3.4	L8: Regional Variation
3.3	P5: Lifespan Standardization
3.2	L2: Housing LCA
3.2	L7: Evaluating Subgrade Construction, Parking and Foundations
3.1	L5: Building Scale/Construction Trends

More details on the survey results, including written support for different projects, is included in Appendix F.

6 NEXT STEPS

The highest ranked project, the development of an LCA Practice Guide, is already funded by the Pankow Foundation, Skanksa USA and Oregon DEQ and will be developed over the course of the year and published by the end of 2017.

The Data Visualization website is live. The Carbon Leadership Forum will explore ways to expand and update the database as well as connect to other embodied carbon database initiatives such as the deQo materials quantity-reporting database.

We hope that the University of Washington along with other organizations will work to develop and obtain funding to advance projects noted above in order to provide the data and tools needed by building industry professionals looking to integrate carbon into life cycle based decision-making.

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University of Washington
College of Built Environments
Department of Architecture

CARBON LEADERSHIP FORUM

Embodied Carbon Benchmark Study

LCA for Low Carbon Construction Project

APPENDIX A: DATABASE

CLF ECB RESEARCH 17.01.31.csv

BLDG_PUB	BLDG_TYP	BLDG_US	BLDG_LOC	BLDG_NEW	$BLDG_AREA_M2	$BLDG_AREA_FT2	BLDG_	$BLDG_ST	LCA_YEAR	LCA_RE	LCA_SOUR	LCA_STAG	LCA_BLDG	LCA_MAT_	EC_WB_EX	EC_LCAA_PERM2
A00	Commerci	Mixed use	Middle Ea	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	2567.39	2521.63
A00	Commerci	Other	North Am	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2016	40	41	AB	SF	Y	1699.34	1332.55
A00	Commerci	Office	Europe	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	1303.39	1031.76
A00	Commerci	Other	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2016	40	41	AB	SF	Y	1211.33	938.69
A00	Commerci	Office	Asia-Pacifi	New	Over 92903	Over 1 million	0	15 to 25	2016	40	41	AB	SF	Y	1087.86	937.59
A00	Commerci	Office	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	1 to 6	2016	40	41	AB	SF	Y	992.27	923.3
A00	Commerci	Other	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2016	40	41	AB	SF	Y	1185.57	917.93
A00	Commerci	Other	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2016	40	41	AB	SF	Y	1140.08	882.65
A00	Commerci	Other	North Am	New	46452 to 92903	500,001 to 1 million	0	1 to 6	2016	40	41	AB	SF	Y	856.41	844.49
A00	Commerci	Office	North Am	New	Over 92903	Over 1 million	0	More than	2016	40	41	AB	SF	Y	840.69	772.05
A00	Commerci	Office	Asia-Pacifi	New	Over 92903	Over 1 million	0	More than	2016	40	41	AB	SF	Y	968.37	748.03
A00	Commerci	Other	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	1 to 6	2016	40	41	AB	SF	Y	906.85	740.7
A00	Commerci	Other	North Am	New	Over 92903	Over 1 million	0	15 to 25	2016	40	41	AB	SF	Y	830.01	733.88
A00	Residentia	Multi-fami	Asia-Pacifi	New	18581 to 46451	200,001 to 500,000	0	More than	2016	40	41	AB	SF	Y	913.19	731.63
A00	Commerci	Other	North Am	New	46452 to 92903	500,001 to 1 million	0	1 to 6	2016	40	41	AB	SF	Y	944.42	730.52
A00	Commerci	Office	Asia-Pacifi	New	Over 92903	Over 1 million	0	1 to 6	2016	40	41	AB	SF	Y	920.16	724.64
A00	Commerci	Mixed use	Asia-Pacifi	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2016	40	41	AB	SF	Y	918.44	722.29
A00	Commerci	Office	North Am	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2016	40	41	AB	SF	Y	936.09	717.52
A00	Commerci	Other	Asia-Pacifi	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2016	40	41	AB	SF	Y	764.22	704.78
A00	Commerci	Lodging	Middle Ea	New	Over 92903	Over 1 million	0	More than	2016	40	41	AB	SF	Y	888.08	687.05
A00	Commerci	Other	Asia-Pacifi	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2016	40	41	AB	SF	Y	834.06	685.14
A00	Residentia	Multi-fami	Asia-Pacifi	New	18581 to 46451	200,001 to 500,000	0	More than	2016	40	41	AB	SF	Y	844.54	682.25
A00	Residentia	Multi-fami	Asia-Pacifi	New	18581 to 46451	200,001 to 500,000	0	15 to 25	2016	40	41	AB	SF	Y	837.65	674.22
A00	Commerci	Office	Asia-Pacifi	New	4646 to 9290	50,001 to 100,000	0	7 to 14	2016	40	41	AB	SF	Y	794.88	673.25
A00	Commerci	Mixed use	Europe	New	Over 92903	Over 1 million	0	More than	2016	40	41	AB	SF	Y	726.44	645.19
A00	Commerci	Office	Asia-Pacifi	New	18581 to 46451	200,001 to 500,000	0	15 to 25	2016	40	41	AB	SF	Y	708.31	643.89
A00	Commerci	Mixed use	Asia-Pacifi	New	Over 92903	Over 1 million	0	More than	2016	40	41	AB	SF	Y	747.62	636.62
A00	Commerci	Office	Asia-Pacifi	New	Over 92903	Over 1 million	0	More than	2016	40	41	AB	SF	Y	803.17	620.59
A00	Commerci	Office	Asia-Pacifi	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2016	40	41	AB	SF	Y	779.14	619.74
A00	Commerci	Office	Asia-Pacifi	New	Over 92903	Over 1 million	0	More than	2016	40	41	AB	SF	Y	781.31	603.72
A00	Commerci	Office	Middle Ea	New	Over 92903	Over 1 million	0	More than	2016	40	41	AB	SF	Y	749.32	595.91
A00	Commerci	Office	Asia-Pacifi	New	Over 92903	Over 1 million	0	More than	2016	40	41	AB	SF	Y	712.96	590.35
A00	Commerci	Office	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	769.74	583.2
A00	Commerci	Other	Asia-Pacifi	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2016	40	41	AB	SF	Y	635.78	582.83
A00	Residentia	Multi-fami	North Am	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	728.34	581.32
A00	Commerci	Other	Asia-Pacifi	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2016	40	41	AB	SF	Y	670.62	579.16
A00	Commerci	Office	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2016	40	41	AB	SF	Y	686.86	578.9
A00	Commerci	Office	Europe	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2016	40	41	AB	SF	Y	713.19	575.17
A00	Commerci	Office	North Am	New	Over 92903	Over 1 million	0	15 to 25	2016	40	41	AB	SF	Y	710.71	574.36
A00	Commerci	Other	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	1 to 6	2016	40	41	AB	SF	Y	707.13	572.07
A00	Commerci	Other	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2016	40	41	AB	SF	Y	695.77	563.73
A00	Commerci	Office	North Am	New	18581 to 46451	200,001 to 500,000	0	More than	2016	40	41	AB	SF	Y	665.67	561.49
A00	Residentia	Multi-fami	North Am	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	692.97	553.79
A00	Commerci	Lodging	Asia-Pacifi	New	4646 to 9290	50,001 to 100,000	0	More than	2016	40	41	AB	SF	Y	641.71	542.2
A00	Commerci	Office	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	667.47	533.9
A00	Commerci	Lodging	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	690.45	533.58

A00	Commerci	Office	Asia-Pacifi	New	9291 to 18580	100,001 to 200,000	0	15 to 25	2016	40	41	AB	SF	Y	601.09	529.3
A00	Commerci	Office	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	662.42	525.5
A00	Commerci	Other	Middle Eas	New	Over 92903	Over 1 million	0	1 to 6	2016	40	41	AB	SF	Y	684.39	522.68
A00	Commerci	Office	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	656.95	521.6
A00	Commerci	Office	North Ame	New	466 to 929	5,001 to 10,000	0	1 to 6	2016	40	41	AB	SF	Y	636.14	517.89
A00	Commerci	Office	Europe	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	649.63	517.12
A00	Commerci	Office	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	666.56	514.75
A00	Residentia	Multi-fami	Asia-Pacifi	New	18581 to 46451	200,001 to 500,000	0	15 to 25	2016	40	41	AB	SF	Y	615.94	511.46
A00	Commerci	Other	North Ame	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2016	40	41	AB	SF	Y	634.04	511.39
A00	Commerci	Mixed use	Europe	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	653.81	505.26
A00	Commerci	Office	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	15 to 25	2016	40	41	AB	SF	Y	651.81	503.81
A00	Commerci	Other	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	1 to 6	2016	40	41	AB	SF	Y	601.58	501.89
A00	Commerci	Other	Asia-Pacifi	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2016	40	41	AB	SF	Y	639.32	493.88
A00	Commerci	Office	Asia-Pacifi	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2016	40	41	AB	SF	Y	570.98	492.23
A00	Commerci	Office	Asia-Pacifi	New	Over 92903	Over 1 million	0	7 to 14	2016	40	41	AB	SF	Y	560.63	491.75
A00	Commerci	Office	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	637.23	491.74
A00	Commerci	Office	Asia-Pacifi	New	Over 92903	Over 1 million	0	More than	2016	40	41	AB	SF	Y	634.29	490.19
A00	Commerci	Office	Asia-Pacifi	New	Over 92903	Over 1 million	0	15 to 25	2016	40	41	AB	SF	Y	606.78	490.11
A00	Commerci	Office	Asia-Pacifi	New	Over 92903	Over 1 million	0	More than	2016	40	41	AB	SF	Y	587.14	485.95
A00	Commerci	Office	Asia-Pacifi	New	18581 to 46451	200,001 to 500,000	0	More than	2016	40	41	AB	SF	Y	595.56	485.79
A00	Residentia	Multi-fami	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	599.12	478.97
A00	Commerci	Other	North Ame	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2016	40	41	AB	SF	Y	611.95	473.77
A00	Commerci	Office	Asia-Pacifi	New	Over 92903	Over 1 million	0	More than	2016	40	41	AB	SF	Y	570.73	473.32
A00	Residentia	Multi-fami	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2016	40	41	AB	SF	Y	592.36	473.26
A00	Commerci	Other	Asia-Pacifi	New	Over 92903	Over 1 million	0	7 to 14	2016	40	41	AB	SF	Y	569.02	472.28
A00	Commerci	Office	Asia-Pacifi	New	Over 92903	Over 1 million	0	7 to 14	2016	40	41	AB	SF	Y	573.27	471.3
A00	Residentia	Multi-fami	North Ame	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	584.9	470.11
A00	Commerci	Mixed use	North Ame	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	576.23	469.77
A00	Commerci	Mixed use	Asia-Pacifi	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2016	40	41	AB	SF	Y	606.36	467.69
A00	Commerci	Office	Asia-Pacifi	New	930 to 2323	10,001 to 25,000	0	7 to 14	2016	40	41	AB	SF	Y	590.23	466.84
A00	Residentia	Multi-fami	North Ame	New	Over 92903	Over 1 million	0	More than	2016	40	41	AB	SF	Y	552.83	465.66
A00	Commerci	Office	Asia-Pacifi	New	Over 92903	Over 1 million	0	More than	2016	40	41	AB	SF	Y	572.91	465.02
A00	Commerci	Office	Asia-Pacifi	New	18581 to 46451	200,001 to 500,000	0	More than	2016	40	41	AB	SF	Y	591.39	464.89
A00	Commerci	Office	North Ame	New	46452 to 92903	500,001 to 1 million	0	15 to 25	2016	40	41	AB	SF	Y	563.33	464.32
A00	Commerci	Office	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	520.71	462.89
A00	Commerci	Office	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	15 to 25	2016	40	41	AB	SF	Y	546.87	457.53
A00	Commerci	Mixed use	Middle Eas	New	Over 92903	Over 1 million	0	More than	2016	40	41	AB	SF	Y	569.86	455.78
A00	Commerci	Other	North Ame	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2016	40	41	AB	SF	Y	584.46	451.28
A00	Commerci	Office	Europe	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2016	40	41	AB	SF	Y	504.79	446.21
A00	Residentia	Multi-fami	Asia-Pacifi	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2016	40	41	AB	SF	Y	555.91	440.55
A00	Commerci	Lodging	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	518.02	439.96
A00	Commerci	Office	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	564.22	439.41
A00	Residentia	Multi-fami	Asia-Pacifi	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2016	40	41	AB	SF	Y	550.38	436.33
A00	Commerci	Parking	North Ame	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2016	40	41	AB	SF	Y	529.36	436.12
A00	Commerci	Other	Asia-Pacifi	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2016	40	41	AB	SF	Y	540.7	435.64
A00	Commerci	Other	North Ame	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2016	40	41	AB	SF	Y	555.11	434.15
A00	Residentia	Multi-fami	North Ame	New	18581 to 46451	200,001 to 500,000	0	15 to 25	2016	40	41	AB	SF	Y	538.43	432.01

A00	Commerci	Office	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	543.65	430.91
A00	Commerci	Office	Asia-Pacifi	New	18581 to 46451	200,001 to 500,000	0	15 to 25	2016	40	41	AB	SF	Y	551	425.53
A00	Commerci	Office	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	530.69	423.37
A00	Commerci	Office	Asia-Pacifi	New	Over 92903	Over 1 million	0	More than	2016	40	41	AB	SF	Y	474.65	422.82
A00	Commerci	Office	North Am	New	46452 to 92903	500,001 to 1 million	0	15 to 25	2016	40	41	AB	SF	Y	510.01	418.31
A00	Residentia	Multi-fami	Asia-Pacifi	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2016	40	41	AB	SF	Y	502.08	416.98
A00	Commerci	Office	North Am	New	Over 92903	Over 1 million	0	More than	2016	40	41	AB	SF	Y	527.01	416.63
A00	Commerci	Mixed use	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2016	40	41	AB	SF	Y	521.48	415.61
A00	Commerci	Office	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2016	40	41	AB	SF	Y	493.18	415.26
A00	Residentia	Multi-fami	Asia-Pacifi	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2016	40	41	AB	SF	Y	510.08	413.97
A00	Residentia	Multi-fami	Asia-Pacifi	New	2324 to 4645	25,001 to 50,000	0	7 to 14	2016	40	41	AB	SF	Y	508.7	404.68
A00	Residentia	Multi-fami	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	507.88	403.27
A00	Residentia	Multi-fami	Asia-Pacifi	New	4646 to 9290	50,001 to 100,000	0	7 to 14	2016	40	41	AB	SF	Y	505.64	401.06
A00	Commerci	Office	Asia-Pacifi	New	Over 92903	Over 1 million	0	More than	2016	40	41	AB	SF	Y	493.66	398.34
A00	Residentia	Multi-fami	North Am	New	18581 to 46451	200,001 to 500,000	0	More than	2016	40	41	AB	SF	Y	494.99	395.21
A00	Commerci	Office	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	15 to 25	2016	40	41	AB	SF	Y	505.14	391.98
A00	Commerci	Other	Asia-Pacifi	New	18581 to 46451	200,001 to 500,000	0	More than	2016	40	41	AB	SF	Y	493.48	387.9
A00	Commerci	Lodging	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	501.7	386.92
A00	Residentia	Multi-fami	North Am	New	46452 to 92903	500,001 to 1 million	0	15 to 25	2016	40	41	AB	SF	Y	495.34	382.12
A00	Residentia	Multi-fami	Asia-Pacifi	New	18581 to 46451	200,001 to 500,000	0	More than	2016	40	41	AB	SF	Y	479.89	377.97
A00	Commerci	Other	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2016	40	41	AB	SF	Y	496.26	376.77
A00	Commerci	Office	Asia-Pacifi	New	Over 92903	Over 1 million	0	More than	2016	40	41	AB	SF	Y	465.87	376.55
A00	Commerci	Office	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2016	40	41	AB	SF	Y	582.73	374.09
A00	Commerci	Office	North Am	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2016	40	41	AB	SF	Y	483.64	373.32
A00	Commerci	Other	Asia-Pacifi	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2016	40	41	AB	SF	Y	456.99	371.39
A00	Commerci	Other	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2016	40	41	AB	SF	Y	459.71	371.22
A00	Commerci	Office	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	450.49	369.65
A00	Commerci	Education	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2016	40	41	AB	SF	Y	452.68	369.16
A00	Commerci	Lodging	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	15 to 25	2016	40	41	AB	SF	Y	434.29	367.59
A00	Commerci	Other	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2016	40	41	AB	SF	Y	433.19	367.47
A00	Residentia	Multi-fami	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2016	40	41	AB	SF	Y	482.28	365.74
A00	Commerci	Education	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2016	40	41	AB	SF	Y	450.66	363.77
A00	Commerci	Other	Asia-Pacifi	New	Over 92903	Over 1 million	0	7 to 14	2016	40	41	AB	SF	Y	459.44	363.71
A00	Commerci	Other	North Am	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2016	40	41	AB	SF	Y	458.4	359.4
A00	Commerci	Office	Europe	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2016	40	41	AB	SF	Y	440.55	356.64
A00	Commerci	Office	Asia-Pacifi	New	9291 to 18580	100,001 to 200,000	0	15 to 25	2016	40	41	AB	SF	Y	448.38	354.58
A00	Commerci	Mixed use	Asia-Pacifi	New	Over 92903	Over 1 million	0	More than	2016	40	41	AB	SF	Y	443.63	351.45
A00	Commerci	Office	Middle Ea	New	46452 to 92903	500,001 to 1 million	0	15 to 25	2016	40	41	AB	SF	Y	453.41	349.87
A00	Residentia	Multi-fami	North Am	New	18581 to 46451	200,001 to 500,000	0	15 to 25	2016	40	41	AB	SF	Y	435.03	349.02
A00	Commerci	Lodging	Europe	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	418.3	345.82
A00	Commerci	Other	Asia-Pacifi	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2016	40	41	AB	SF	Y	399.2	344.79
A00	Commerci	Office	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2016	40	41	AB	SF	Y	395.53	344.24
A00	Residentia	Multi-fami	North Am	New	Over 92903	Over 1 million	0	More than	2016	40	41	AB	SF	Y	426.27	343.97
A00	Residentia	Multi-fami	North Am	New	18581 to 46451	200,001 to 500,000	0	More than	2016	40	41	AB	SF	Y	434.42	341.67
A00	Residentia	Multi-fami	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	437.6	337.64
A00	Commerci	Other	Asia-Pacifi	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2016	40	41	AB	SF	Y	383.18	336.78
A00	Commerci	Office	North Am	New	18581 to 46451	200,001 to 500,000	0	More than	2016	40	41	AB	SF	Y	404.09	334.13

A00	Commerci	Education	North Am	New	18581 to 46451	200,001 to 500,000	0	More than	2016	40	41	AB	SF	Y	426.59	333.84
A00	Commerci	Other	Asia-Pacifi	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2016	40	41	AB	SF	Y	432.74	333.82
A00	Commerci	Office	Asia-Pacifi	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2016	40	41	AB	SF	Y	422.99	330.38
A00	Residentia	Multi-fami	North Am	New	18581 to 46451	200,001 to 500,000	0	15 to 25	2016	40	41	AB	SF	Y	426.79	329.21
A00	Commerci	Other	Asia-Pacifi	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2016	40	41	AB	SF	Y	395.87	320.76
A00	Commerci	Office	North Am	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	407.74	317.23
A00	Commerci	Parking	Asia-Pacifi	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2016	40	41	AB	SF	Y	379.02	314.93
A00	Commerci	Office	North Am	New	Over 92903	Over 1 million	0	More than	2016	40	41	AB	SF	Y	394.48	314.44
A00	Commerci	Office	North Am	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	414.77	313.63
A00	Residentia	Multi-fami	South Am	New	18581 to 46451	200,001 to 500,000	0	15 to 25	2016	40	41	AB	SF	Y	389.67	310.47
A00	Commerci	Office	North Am	New	46452 to 92903	500,001 to 1 million	0	15 to 25	2016	40	41	AB	SF	Y	349.88	310.4
A00	Commerci	Office	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2016	40	41	AB	SF	Y	381.22	309.79
A00	Residentia	Multi-fami	Europe	New	46452 to 92903	500,001 to 1 million	0	15 to 25	2016	40	41	AB	SF	Y	386.53	308.56
A00	Commerci	Lodging	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2016	40	41	AB	SF	Y	386.06	308.43
A00	Commerci	Office	North Am	New	Over 92903	Over 1 million	0	More than	2016	40	41	AB	SF	Y	389.57	308.32
A00	Commerci	Lodging	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2016	40	41	AB	SF	Y	378.23	300.12
A00	Residentia	Multi-fami	North Am	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2016	40	41	AB	SF	Y	387.69	299.21
A00	Residentia	Multi-fami	North Am	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	358.06	296.6
A00	Commerci	Office	North Am	New	18581 to 46451	200,001 to 500,000	0	15 to 25	2016	40	41	AB	SF	Y	367.79	293.19
A00	Commerci	Other	North Am	New	46452 to 92903	500,001 to 1 million	0	1 to 6	2016	40	41	AB	SF	Y	317.25	290
A00	Commerci	Other	Asia-Pacifi	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2016	40	41	AB	SF	Y	359.02	287.36
A00	Residentia	Multi-fami	Europe	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2016	40	41	AB	SF	Y	356.56	284.02
A00	Commerci	Office	Europe	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2016	40	41	AB	SF	Y	357.83	283.83
A00	Commerci	Office	Middle Ea	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2016	40	41	AB	SF	Y	354.88	277.61
A00	Commerci	Other	North Am	New	46452 to 92903	500,001 to 1 million	0	1 to 6	2016	40	41	AB	SF	Y	368.07	277.15
A00	Commerci	Other	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2016	40	41	AB	SF	Y	312.32	272.6
A00	Commerci	Other	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2016	40	41	AB	SF	Y	345.69	270.4
A00	Commerci	Office	North Am	New	Over 92903	Over 1 million	0	7 to 14	2016	40	41	AB	SF	Y	301.23	254.88
A00	Residentia	Multi-fami	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2016	40	41	AB	SF	Y	325.03	250.26
A00	Commerci	Office	North Am	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2016	40	41	AB	SF	Y	297.97	248.17
A00	Commerci	Office	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2016	40	41	AB	SF	Y	288.04	246.64
A00	Commerci	Education	Asia-Pacifi	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2016	40	41	AB	SF	Y	270.16	245.4
A00	Commerci	Parking	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2016	40	41	AB	SF	Y	307.82	244.25
A00	Commerci	Office	North Am	New	46452 to 92903	500,001 to 1 million	0	More than	2016	40	41	AB	SF	Y	307.1	242.93
A00	Commerci	Other	Asia-Pacifi	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2016	40	41	AB	SF	Y	315.59	242.18
A00	Commerci	Other	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2016	40	41	AB	SF	Y	317.35	234.87
A00	Commerci	Education	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2016	40	41	AB	SF	Y	266.05	233.81
A00	Commerci	Other	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2016	40	41	AB	SF	Y	287.09	225.27
A00	Commerci	Office	Asia-Pacifi	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2016	40	41	AB	SF	Y	281.03	217.14
A00	Commerci	Office	North Am	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2016	40	41	AB	SF	Y	272.29	215.95
A00	Commerci	Office	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2016	40	41	AB	SF	Y	277.24	212.57
A00	Commerci	Office	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2016	40	41	AB	SF	Y	260.45	212.04
A00	Commerci	Office	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2016	40	41	AB	SF	Y	228.93	182.17
A00	Commerci	Office	North Am	New	18581 to 46451	200,001 to 500,000	0	15 to 25	2016	40	41	AB	SF	Y	225.7	180.02
A00	Commerci	Other	North Am	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2016	40	41	AB	SF	Y	205.02	165.08
A00	Commerci	Office	North Am	New	46452 to 92903	500,001 to 1 million	0	1 to 6	2016	40	41	AB	SF	Y	158.63	129.03
A00	Commerci	Office	Asia-Pacifi	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2016	40	41	AB	SF	Y	159.4	125.47

A01	Commerci	Public Ord	Europe	New	46452 to 92903	500,001 to 1 million	0	1 to 6	2010		A	SF	N	37511	793.88
A01	Commerci	Education	Europe	New	930 to 2323	10,001 to 25,000	0	1 to 6	2010		A	SFEI	N	1145	729.61
A01	Commerci	Office	Europe	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2012	60	ABC	SFEI	N	7510	700
A01	Commerci	Office	Europe	Renovatio	2324 to 4645	25,001 to 50,000	0	7 to 14	2013		A	SF	N	85709.63	672.05
A01	Residentia	Other	Europe	New	2324 to 4645	25,001 to 50,000	0	7 to 14	2015		A	SF	N	84976.7	668.33
A01	Residentia	Other	Europe	New	94 to 465	1,001 to 5,000	0	7 to 14	2015	60	ABC	SFEI	N	84243.77	664.6
A01	Commerci	Education	Europe	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2015	60	ABC	SFEI	N	83510.84	660.88
A01	Commerci	Office	Europe	New	4646 to 9290	50,001 to 100,000	0	7 to 14	2014	60	ABC	SFEI	N	82777.9	657.15
A01	Commerci	Mercantile	Europe	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2015		A	SFEI	N	82044.97	653.43
A01	Residentia	Other	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2008		A	SFEI	N	81312.04	649.71
A01	Commerci	Office	Europe	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2008		A	SFEI	N	80579.11	645.98
A01	Commerci	Office	Europe	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2009		A	SFEI	N	79846.18	642.26
A01	Commerci	Mixed	Europe	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2013	60	AB	SFEI	N	36654	640.75
A01	Commerci	Mixed	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2009	60	AB	SFEI	N	79113.25	638.53
A01	Commerci	Education	Europe	New	930 to 2323	10,001 to 25,000	0	7 to 14	2009		A	SFEI	N	78380.31	634.81
A01	Commerci	Education	Europe	New	2324 to 4645	25,001 to 50,000	0	7 to 14	2009		A	SF	N	77647.38	631.08
A01	Commerci	Public Ord	Europe	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2008		A	SF	N	76914.45	627.36
A01	Residentia	Other	Europe	New	2324 to 4645	25,001 to 50,000	0	7 to 14	1990		A	SF	N	76181.52	623.64
A01	Residentia	Other	Europe	Renovatio	2324 to 4645	25,001 to 50,000	0	7 to 14	2008		A	SF	N	75448.59	619.91
A01	Commerci	Office	Europe	New	93 or less	1,000 or less	0	7 to 14	2008		A	SF	N	74715.66	616.19
A01	Commerci	Office	Europe	New	93 or less	1,000 or less	0	7 to 14	2008		A	SF	N	73982.72	612.46
A01	Commerci	Office	Europe	New	93 or less	1,000 or less	0	7 to 14	2008		A	SF	N	73249.79	608.74
A01	Commerci	Office	Europe	New	93 or less	1,000 or less	0	7 to 14	2008		A	SF	N	72516.86	605.01
A01	Commerci	Office	Europe	New	93 or less	1,000 or less	0	7 to 14	1990		A	SF	N	71783.93	601.29
A01	Commerci	Office	Europe	New	93 or less	1,000 or less	0	7 to 14	2009		A	SF	N	71051	597.57
A01	Commerci	Public Asse	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2010		A	SF	N	20825	597
A01	Commerci	Office	Europe	New	93 or less	1,000 or less	0	7 to 14	2008		A	SF	N	70318.06	593.84
A01	Commerci	Office	Europe	New	93 or less	1,000 or less	0	7 to 14	2008		A	SF	N	69585.13	590.12
A01	Commerci	Public Asse	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2008		A	SF	N	68852.2	586.39
A01	Commerci	Mixed	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2008		A	SF	N	68119.27	582.67
A01	Commerci	Mixed	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2008		A	SF	N	67386.34	578.95
A01	Commerci	Mixed	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2009		A	SF	N	66653.41	575.22
A01	Commerci	Mixed	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2008		A	SF	N	65920.47	571.5
A01	Commerci	Mixed	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2008		A	SF	N	65187.54	567.77
A01	Commerci	Office	Europe	Renovatio	2324 to 4645	25,001 to 50,000	0	7 to 14	2008		A	SF	N	64454.61	564.05
A01	Residentia	Other	Europe	New	2324 to 4645	25,001 to 50,000	0	7 to 14	2008		A	SF	N	63721.68	560.32
A01	Residentia	Other	Europe	New	94 to 465	1,001 to 5,000	0	7 to 14	2008	60	ABC	SFEI	N	62988.75	556.6
A01	Commerci	Education	Europe	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2009	60	ABC	SFEI	N	62255.82	552.88
A01	Commerci	Office	Europe	New	4646 to 9290	50,001 to 100,000	0	7 to 14	2013	60	ABC	SFEI	N	61522.88	549.15
A01	Commerci	Mercantile	Europe	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2012		A	SFEI	N	60789.95	545.43
A01	Residentia	Other	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011		A	SFEI	N	60057.02	541.7
A01	Commerci	Office	Europe	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2011		A	SFEI	N	59324.09	537.98
A01	Residentia	Other	Europe	New	2324 to 4645	25,001 to 50,000	0	7 to 14	2010		A	SF	N	1919	536.48
A01	Commerci	Office	Europe	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2011		A	SFEI	N	58591.16	534.25
A01	Commerci	Mixed	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011	60	AB	SFEI	N	57858.22	530.53
A01	Commerci	Education	Europe	New	930 to 2323	10,001 to 25,000	0	7 to 14	2011		A	SFEI	N	57125.29	526.81
A01	Commerci	Education	Europe	New	2324 to 4645	25,001 to 50,000	0	7 to 14	2011		A	SF	N	56392.36	523.08

A01	Commerci Public Ord	Europe	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2011		A	SF	N	55659.43	519.36
A01	Residentia Other	Europe	New	2324 to 4645	25,001 to 50,000	0	7 to 14	2011		A	SF	N	54926.5	515.63
A01	Residentia Other	Europe	Renovatio	2324 to 4645	25,001 to 50,000	0	7 to 14	2011		A	SF	N	54193.57	511.91
A01	Commerci Office	Europe	New	93 or less	1,000 or less	0	7 to 14	2011		A	SF	N	53460.63	508.18
A01	Commerci Office	Europe	New	93 or less	1,000 or less	0	7 to 14	2011		A	SF	N	52727.7	504.46
A01	Commerci Office	Europe	New	93 or less	1,000 or less	0	7 to 14	2013		A	SF	N	51994.77	500.74
A01	Commerci Office	Europe	New	93 or less	1,000 or less	0	7 to 14	2007		A	SF	N	51261.84	497.01
A01	Commerci Office	Europe	Renovatio	2324 to 4645	25,001 to 50,000	0	7 to 14	2010		A	SF	N	1896	496.21
A01	Commerci Office	Europe	New	93 or less	1,000 or less	0	7 to 14	2007		A	SF	N	50528.91	493.29
A01	Commerci Office	Europe	New	93 or less	1,000 or less	0	7 to 14	2007		A	SF	N	49795.98	489.56
A01	Commerci Office	Europe	New	93 or less	1,000 or less	0	7 to 14	2007		A	SF	N	49063.04	485.84
A01	Commerci Office	Europe	New	93 or less	1,000 or less	0	7 to 14	2011		A	SF	N	48330.11	482.12
A01	Commerci Public Ass	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011		A	SF	N	47597.18	478.39
A01	Commerci Mixed	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011		A	SF	N	46864.25	474.67
A01	Commerci Mixed	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011		A	SF	N	46131.32	470.94
A01	Commerci Mixed	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011		A	SF	N	45398.38	467.22
A01	Commerci Mixed	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011		A	SF	N	44665.45	463.49
A01	Commerci Mixed	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011		A	SF	N	43932.52	459.77
A01	Commerci Office	Europe	Renovatio	2324 to 4645	25,001 to 50,000	0	7 to 14	2011		A	SF	N	43199.59	456.05
A01	Residentia Other	Europe	New	2324 to 4645	25,001 to 50,000	0	7 to 14	2011		A	SF	N	42466.66	452.32
A01	Residentia Other	Europe	New	94 to 465	1,001 to 5,000	0	7 to 14	2011	60	ABC	SFEI	N	41733.73	448.6
A01	Commerci Education	Europe	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2011	60	ABC	SFEI	N	41000.79	444.87
A01	Commerci Office	Europe	New	4646 to 9290	50,001 to 100,000	0	7 to 14	2011	60	ABC	SFEI	N	40267.86	441.15
A01	Commerci Mercantile	Europe	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2011		A	SFEI	N	39534.93	437.42
A01	Residentia Other	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011		A	SFEI	N	38802	433.7
A01	Commerci Office	Europe	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2011		A	SFEI	N	38069.07	429.98
A01	Commerci Office	Europe	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2011		A	SFEI	N	37336.14	426.25
A01	Commerci Mixed	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011	60	AB	SFEI	N	36603.2	422.53
A01	Commerci Education	Europe	New	930 to 2323	10,001 to 25,000	0	7 to 14	2011		A	SFEI	N	35870.27	418.8
A01	Commerci Education	Europe	New	2324 to 4645	25,001 to 50,000	0	7 to 14	2011		A	SF	N	35137.34	415.08
A01	Commerci Public Ord	Europe	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2011		A	SF	N	34404.41	411.36
A01	Residentia Other	Europe	New	2324 to 4645	25,001 to 50,000	0	7 to 14	2011		A	SF	N	33671.48	407.63
A01	Residentia Other	Europe	Renovatio	2324 to 4645	25,001 to 50,000	0	7 to 14	2011		A	SF	N	32938.55	403.91
A01	Commerci Office	Europe	New	93 or less	1,000 or less	0	7 to 14	2011		A	SF	N	32205.61	400.18
A01	Commerci Office	Europe	New	93 or less	1,000 or less	0	7 to 14	2011		A	SF	N	31472.68	396.46
A01	Commerci Office	Europe	New	93 or less	1,000 or less	0	7 to 14	2011		A	SF	N	30739.75	392.73
A01	Commerci Office	Europe	New	93 or less	1,000 or less	0	7 to 14	2011		A	SF	N	30006.82	389.01
A01	Commerci Office	Europe	New	93 or less	1,000 or less	0	7 to 14	2011		A	SF	N	29273.89	385.29
A01	Commerci Office	Europe	New	93 or less	1,000 or less	0	7 to 14	2011		A	SF	N	28540.95	381.56
A01	Commerci Office	Europe	New	93 or less	1,000 or less	0	7 to 14	2011		A	SF	N	27808.02	377.84
A01	Commerci Office	Europe	New	93 or less	1,000 or less	0	7 to 14	2011		A	SF	N	27075.09	374.11
A01	Commerci Public Ass	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011		A	SF	N	26342.16	370.39
A01	Commerci Mixed	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011		A	SF	N	25609.23	366.66
A01	Commerci Mixed	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011		A	SF	N	24876.3	362.94
A01	Commerci Mixed	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011		A	SF	N	24143.36	359.22
A01	Commerci Mixed	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011		A	SF	N	23410.43	355.49
A01	Commerci Mixed	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011		A	SF	N	22677.5	351.77

A01	Commerci	Office	Europe	Renovatio	2324 to 4645	25,001 to 50,000	0	7 to 14	2011			A	SF	N	21944.57	348.04
A01	Residentia	Other	Europe	New	2324 to 4645	25,001 to 50,000	0	7 to 14	2011			A	SF	N	21211.64	344.32
A01	Commerci	Education	Europe	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2010			A	SF	N	1470	341.86
A01	Commerci	Mixed	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2010			A	SF	N	6761	303.39
A01	Commerci	Mixed	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2010			A	SF	N	6096	273.55
A01	Commerci	Mixed	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2010			A	SF	N	5745	257.8
A01	Commerci	Mixed	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2010			A	SF	N	5505	247.03
A01	Residentia	Other	Europe	New	2324 to 4645	25,001 to 50,000	0	7 to 14	2010			A	SF	N	787	220.02
A01	Commerci	Mixed	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2010			A	SF	N	4672	209.65
A01	Residentia	Other	Europe	New	94 to 465	1,001 to 5,000	0	1 to 6	2012	60		ABC	SFEI	N	101	200
A01	Commerci	Education	Europe	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2011	60		ABC	SFEI	N		100
A01	Commerci	Office	Europe	New	93 or less	1,000 or less	0	More than	2010			A	SF	N	0.07	70
A01	Commerci	Office	Europe	New	93 or less	1,000 or less	0	More than	2010			A	SF	N	0.07	70
A01	Commerci	Office	Europe	New	93 or less	1,000 or less	0	More than	2010			A	SF	N	0.07	70
A01	Commerci	Office	Europe	New	93 or less	1,000 or less	0	7 to 14	2010			A	SF	N	0.05	50
A01	Commerci	Office	Europe	New	93 or less	1,000 or less	0	More than	2010			A	SF	N	0.05	50
A01	Residentia	Other	Europe	Renovatio	2324 to 4645	25,001 to 50,000	0	7 to 14	2010			A	SF	N	163	42.66
A01	Commerci	Office	Europe	New	93 or less	1,000 or less	0	7 to 14	2010			A	SF	N	0.03	30
A01	Commerci	Office	Europe	New	93 or less	1,000 or less	0	7 to 14	2010			A	SF	N	0.03	30
A01	Commerci	Office	Europe	New	93 or less	1,000 or less	0	7 to 14	2010			A	SF	N	0.01	10
A01	Commerci	Office	Europe	New	46452 to 92903	500,001 to 1 million	0	More than	2013			A	SFEI	N	69959	
A01	Commerci	Office	Europe	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2013			A	SFEI	N	43461	
A01	Residentia	Other	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2013			A	SFEI	N	15157	
A01	Commerci	Mercantile	Europe	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2013			A	SFEI	N	9229	
A02	Commerci	Education	North Am	New	466 to 929	5,001 to 10,000	0	1 to 6	2014	50	14	A	SF	Y	1817.19	2745
A02	Commerci	Other	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2014	50	14	A	SF	Y	2591.6	2728
A02	Commerci	Mixed	Middle Ea	New	Over 92903	Over 1 million	0	More than	2013	50	14	A	SF	Y	1464614	2661
A02	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	50	14	A	SF	Y	10038.34	2156
A02	Commerci	Health Car	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2013	50	14	A	SF	Y	3005.46	2156
A02	Commerci	Public Ass	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2013	50	14	A	SF	Y	1956.5	2066
A02	Commerci	Other	North Am	New	466 to 929	5,001 to 10,000	0	1 to 6	2013	50	14	A	SF	Y	1703.31	1929
A02	Commerci	Health Car	North Am	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2014	50	14	A	SF	Y	29839.7	1874
A02	Commerci	Public Ass	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2014	50	14	A	SF	Y	51961.89	1829
A02	Commerci	Public Ass	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2014	50	14	A	SF	Y	51819.84	1824
A02	Commerci	Other	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2014	50	14	A	SF	Y	5863.36	1803
A02	Commerci	Education	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2013	50	14	A	SF	Y	3877.71	1765
A02	Commerci	Other	North Am	New	466 to 929	5,001 to 10,000	0	1 to 6	2014	50	14	A	SF	Y	1389.5	1707
A02	Commerci	Other	North Am	New	46452 to 92903	500,001 to 1 million	0	1 to 6	2014	50	14	A	SF	Y	90802.09	1629
A02	Commerci	Education	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2014	50	14	A	SF	Y	1602.4	1604
A02	Commerci	Education	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2014	50	14	A	SF	Y	1602.4	1604
A02	Commerci	Public Ass	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2014	50	14	A	SF	Y	1602.4	1604
A02	Commerci	Public Ass	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2013	50	14	A	SF	Y	1589.93	1479
A02	Commerci	Health Car	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2015	50	14	A	SF	Y	14378.87	1474
A02	Commerci	Other	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2013	50	14	A	SF	Y	6585.33	1455
A02	Commerci	Other	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	50	14	A	SF	Y	11266.57	1417
A02	Commerci	Other	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2014	50	14	A	SF	Y	12850.99	1386
A02	Commerci	Office	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2014	50	14	A	SF	Y	3315.22	1314

A02	Commerci	Education	North Am	New	466 to 929	5,001 to 10,000	0	1 to 6	2014	50	14	A	SF	Y	745.34	1294
A02	Commerci	Mixed	North Am	New	466 to 929	5,001 to 10,000	0	1 to 6	2013	50	14	A	SF	Y	813.35	1261
A02	Commerci	Other	Middle Ea	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2014	50	14	A	SF	Y	8105.5	1247
A02	Commerci	Health Car	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2013	50	14	A	SF	Y	25946.88	1207
A02	Commerci	Other	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2014	50	14	A	SF	Y	11907.76	1194
A02	Commerci	Public Ass	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2013	50	14	A	SF	Y	20400.97	1187
A02	Commerci	Education	North Am	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2014	50	14	A	SF	Y	13221.53	1186
A02	Commerci	Other	North Am	New	Over 92903	Over 1 million	0	More than	2015	50	14	A	SF	Y	164992.8	1167
A02	Commerci	Office	North Am	New	930 to 2323	10,001 to 25,000	0	15 to 25	2015	50	14	A	SF	Y	1441.51	1108
A02	Commerci	Education	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2014	50	14	A	SF	Y	2020.09	1082
A02	Commerci	Education	Asia-Pacifi	New	930 to 2323	10,001 to 25,000	0	1 to 6	2014	50	14	A	SF	Y	1713.59	1065
A02	Commerci	Mixed	Middle Ea	New	Over 92903	Over 1 million	0	More than	2014	50	14	A	SF	Y	582994.7	1060
A02	Commerci	Education	North Am	New	466 to 929	5,001 to 10,000	0	1 to 6	2014	50	14	A	SF	Y	937.36	1009
A02	Residentia	Other	North Am	New	94 to 465	1,001 to 5,000	0	1 to 6	2015	50	14	A	SF	Y	384.53	1004
A02	Commerci	Education	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2014	50	14	A	SF	Y	2538.54	1001
A02	Commerci	Other	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2014	50	14	A	SF	Y	4252.63	995
A02	Commerci	Health Car	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2014	50	14	A	SF	Y	13097.06	979
A02	Residentia	Multi-fami	North Am	New	4646 to 9290	50,001 to 100,000	0	7 to 14	2013	50	14	A	SF	Y	5511.87	974
A02	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	50	14	A	SF	Y	5563.2	950
A02	Commerci	Public Ass	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2014	50	14	A	SF	Y	18987.05	935
A02	Commerci	Education	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2013	50	14	A	SF	Y	4008.35	927
A02	Commerci	Other	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2014	50	14	A	SF	Y	9478.56	910
A02	Commerci	Public Ass	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2014	50	14	A	SF	Y	12238.59	910
A02	Commerci	Education	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2013	50	14	A	SF	Y	1509.35	876
A02	Commerci	Education	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2014	50	14	A	SF	Y	896.57	873
A02	Commerci	Other	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2014	50	14	A	SF	Y	3236.64	871
A02	Commerci	Mixed	Middle Ea	New	18581 to 46451	200,001 to 500,000	0	More than	2014	50	14	A	SF	Y	37419.57	870
A02	Commerci	Education	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2014	50	14	A	SF	Y	10022.02	863
A02	Commerci	Other	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2013	50	14	A	SF	Y	1907.32	820
A02	Commerci	Lodging	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2014	50	14	A	SF	Y	801.2	802
A02	Commerci	Education	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2014	50	14	A	SF	Y	801.2	802
A02	Commerci	Education	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2014	50	14	A	SF	Y	801.2	802
A02	Commerci	Education	North Am	New	466 to 929	5,001 to 10,000	0	1 to 6	2014	50	14	A	SF	Y	720.27	795
A02	Commerci	Health Car	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2014	50	14	A	SF	Y	6613.55	791
A02	Commerci	Public Ass	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2014	50	14	A	SF	Y	23515.14	790
A02	Commerci	Other	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2014	50	14	A	SF	Y	26807.74	782
A02	Residentia	Other	North Am	New	466 to 929	5,001 to 10,000	0	7 to 14	2014	50	14	A	SF	Y	713.47	768
A02	Commerci	Education	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2013	50	14	A	SF	Y	7854.63	746
A02	Commerci	Other	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2014	50	14	A	SF	Y	16178.57	742
A02	Commerci	Public Ass	Europe	New	4646 to 9290	50,001 to 100,000	0	More than	2014	50	14	A	SF	Y	6129.54	701
A02	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	50	14	A	SF	Y	3509.87	665
A02	Commerci	Public Ass	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2015	50	14	A	SF	Y	11953.07	662
A02	Commerci	Other	North Am	New	94 to 465	1,001 to 5,000	0	1 to 6	2014	50	14	A	SF	Y	280.93	661
A02	Commerci	Education	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2014	50	14	A	SF	Y	24494.68	661
A02	Residentia	Other	North Am	New	18581 to 46451	200,001 to 500,000	0	More than	2013	50	14	A	SF	Y	23304.25	655
A02	Commerci	Health Car	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2015	50	14	A	SF	Y	4361.23	652
A02	Commerci	Public Ass	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2014	50	14	A	SF	Y	3931.39	651

A02	Commerci	Education	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2013	50	14	A	SF	Y	1710.07	648
A02	Commerci	Education	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2014	50	14	A	SF	Y	2589.03	645
A02	Commerci	Public Ass	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2013	50	14	A	SF	Y	935.09	644
A02	Commerci	Other	Europe	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2014	50	14	A	SF	Y	1871.13	643
A02	Residentia	Other	Asia-Pacifi	New	Over 92903	Over 1 million	0	More than	2013	50	14	A	SF	Y	61423.88	639
A02	Commerci	Public Ass	Middle Ea	New	18581 to 46451	200,001 to 500,000	0		2014	50	14	A	SF	Y	15702.58	626
A02	Commerci	Health Car	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	50	14	A	SF	Y	3511.13	621
A02	Commerci	Education	North Am	New	466 to 929	5,001 to 10,000	0	1 to 6	2013	50	14	A	SF	Y	491.75	617
A02	Commerci	Public Ass	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2013	50	14	A	SF	Y	10784.19	610
A02	Commerci	Education	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2013	50	14	A	SF	Y	7892.93	601
A02	Commerci	Education	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2013	50	14	A	SF	Y	18219.27	598
A02	Commerci	Mixed	Middle Ea	New	46452 to 92903	500,001 to 1 million	0	More than	2014	50	14	A	SF	Y	33832.59	597
A02	Commerci	Public Ass	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2013	50	14	A	SF	Y	2548.85	594
A02	Commerci	Mixed	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2014	50	14	A	SF	Y	18674.77	594
A02	Commerci	Education	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2013	50	14	A	SF	Y	1320.5	583
A02	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	50	14	A	SF	Y	2764.98	577
A02	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	50	14	A	SF	Y	3130.56	576
A02	Commerci	Public Ass	Middle Ea	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2013	50	14	A	SF	Y	7980	570
A02	Commerci	Health Car	North Am	New	Over 92903	Over 1 million	0	15 to 25	2014	50	14	A	SF	Y	59764.2	562
A02	Commerci	Public Ass	North Am	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2013	50	14	A	SF	Y	26119.6	561
A02	Commerci	Public Ass	Middle Ea	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2013	50	14	A	SF	Y	2235.84	544
A02	Commerci	Other	North Am	New	466 to 929	5,001 to 10,000	0	1 to 6	2014	50	14	A	SF	Y	428.18	542
A02	Commerci	Other	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2013	50	14	A	SF	Y	31809.5	535
A02	Commerci	Lodging	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2013	50	14	A	SF	Y	617.21	533
A02	Commerci	Health Car	North Am	New	46452 to 92903	500,001 to 1 million	0	15 to 25	2014	50	14	A	SF	Y	35196.66	533
A02	Commerci	Mixed	North Am	New	466 to 929	5,001 to 10,000	0	1 to 6	2014	50	14	A	SF	Y	296.32	532
A02	Commerci	Other	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2014	50	14	A	SF	Y	3086.19	529
A02	Residentia	Other	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2013	50	14	A	SF	Y	13221.65	528
A02	Commerci	Other	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2013	50	14	A	SF	Y	5448.44	516
A02	Commerci	Education	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2013	50	14	A	SF	Y	575.26	515
A02	Commerci	Education	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2014	50	14	A	SF	Y	4838.37	510
A02	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	50	14	A	SF	Y	2567.91	509
A02	Commerci	Health Car	Africa	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2014	50	14	A	SF	Y	31408.12	508
A02	Commerci	Public Ass	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2013	50	14	A	SF	Y	10613.54	507
A02	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	50	14	A	SF	Y	3944.21	487
A02	Commerci	Health Car	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2013	50	14	A	SF	Y	1063.61	485
A02	Commerci	Other	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2014	50	14	A	SF	Y	2484	480
A02	Commerci	Other	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2014	50	14	A	SF	Y	12372.48	480
A02	Commerci	Public Ass	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2014	50	14	A	SF	Y	812.12	478
A02	Residentia	Other	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2013	50	14	A	SF	Y	14430.5	459
A02	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2015	50	14	A	SF	Y	3763.37	456
A02	Commerci	Public Ass	Middle Ea	New	18581 to 46451	200,001 to 500,000	0	15 to 25	2014	50	14	A	SF	Y	8515.04	453
A02	Commerci	Education	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2013	50	14	A	SF	Y	8744.28	446
A02	Commerci	Education	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2013	50	14	A	SF	Y	1922.4	445
A02	Residentia	Other	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2014	50	14	A	SF	Y	666.44	444
A02	Commerci	Other	Asia-Pacifi	New	Over 92903	Over 1 million	0	More than	2013	50	14	A	SF	Y	87313.12	442
A02	Commerci	Public Ass	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2014	50	14	A	SF	Y	5109.72	440

A02	Commerci	Public Asse	North Am	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2013	50	14	A	SF	Y	20392.84	438
A02	Commerci	Mercantile		New	94 to 465	1,001 to 5,000	0	More than	2015	50	14	A	SF	Y	73.85	437
A02	Residentia	Other	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2015	50	14	A	SF	Y	11792.01	437
A02	Commerci	Office	North Am	New	18581 to 46451	200,001 to 500,000	0	15 to 25	2014	50	14	A	SF	Y	8192.44	436
A02	Commerci	Public Asse	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2015	50	14	A	SF	Y	5051.66	435
A02	Commerci	Public Asse	Middle Ea	New	46452 to 92903	500,001 to 1 million	0	More than	2013	50	14	A	SF	Y	25302.36	433
A02	Commerci	Health Car	North Am	New	46452 to 92903	500,001 to 1 million	0	More than	2013	50	14	A	SF	Y	39643.07	428
A02	Commerci	Public Asse	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2013	50	14	A	SF	Y	6498.25	425
A02	Residentia	Other	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	More than	2013	50	14	A	SF	Y	32698.88	424
A02	Commerci	Education	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2013	50	14	A	SF	Y	1007	424
A02	Commerci	Other	Europe	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2015	50	14	A	SF	Y	1252.08	423
A02	Commerci	Other	North Am	New	4646 to 9290	50,001 to 100,000	0	7 to 14	2015	50	14	A	SF	Y	2156.42	422
A02	Commerci	Education	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2013	50	14	A	SF	Y	15644.78	421
A02	Commerci	Mixed	Middle Ea	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2013	50	14	A	SF	Y	10068.45	416
A02	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2014	50	14	A	SF	Y	3453.09	413
A02	Commerci	Mixed	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2013	50	14	A	SF	Y	482.62	409
A02	Commerci	Health Car	Africa	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2015	50	14	A	SF	Y	17136	408
A02	Commerci	Health Car	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2014	50	14	A	SF	Y	10561.28	406
A02	Commerci	Other	North Am	New	Over 92903	Over 1 million	0	More than	2014	50	14	A	SF	Y	68957.33	405
A02	Commerci	Health Car	North Am	New	Over 92903	Over 1 million	0	More than	2014	50	14	A	SF	Y	56569.84	402
A02	Commerci	Public Asse	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2014	50	14	A	SF	Y	5904.98	402
A02	Commerci	Other	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	More than	2015	50	14	A	SF	Y	24380.8	401
A02	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2014	50	14	A	SF	Y	2980.23	401
A02	Commerci	Other	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2014	50	14	A	SF	Y	8988.67	399
A02	Commerci	Other	North Am	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2014	50	14	A	SF	Y	22700.33	392
A02	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	50	14	A	SF	Y	2463.69	391
A02	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	50	14	A	SF	Y	2315.33	389
A02	Commerci	Health Car	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2013	50	14	A	SF	Y	10549.29	389
A02	Commerci	Education	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2013	50	14	A	SF	Y	1646.29	386
A02	Commerci	Education	Middle Ea	New	46452 to 92903	500,001 to 1 million	0	1 to 6	2014	50	14	A	SF	Y	21169.56	383
A02	Commerci	Other	North Am	New	Over 92903	Over 1 million	0	1 to 6	2013	50	14	A	SF	Y	49554	381
A02	Commerci	Public Asse	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2014	50	14	A	SF	Y	7101.84	381
A02	Commerci	Other	North Am	New	Over 92903	Over 1 million	0	More than	2014	50	14	A	SF	Y	42559.62	380
A02	Commerci	Other	Middle Ea	New	Over 92903	Over 1 million	0	More than	2014	50	14	A	SF	Y	38730.77	379
A02	Commerci	Public Asse	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2013	50	14	A	SF	Y	6829.73	377
A02	Commerci	Education	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2014	50	14	A	SF	Y	9381.42	374
A02	Commerci	Education	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2013	50	14	A	SF	Y	1550.41	371
A02	Commerci	Other	North Am	New	Over 92903	Over 1 million	0	More than	2014	50	14	A	SF	Y	51341.11	364
A02	Commerci	Other	Middle Ea	New	Over 92903	Over 1 million	0	7 to 14	2014	50	14	A	SF	Y	144400	361
A02	Commerci	Education	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2013	50	14	A	SF	Y	1435.28	359
A02	Commerci	Other	Asia-Pacifi	New	Over 92903	Over 1 million	0	More than	2014	50	14	A	SF	Y	42720	356
A02	Commerci	Office	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2013	50	14	A	SF	Y	9658.99	356
A02	Residentia	Other	North Am	New	46452 to 92903	500,001 to 1 million	0	More than	2014	50	14	A	SF	Y	26186.22	355
A02	Commerci	Other	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2014	50	14	A	SF	Y	474.14	352
A02	Commerci	Education	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2013	50	14	A	SF	Y	1021.34	344
A02	Commerci	Health Car	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	50	14	A	SF	Y	2319.02	343
A02	Residentia	Other	Asia-Pacifi	New	4646 to 9290	50,001 to 100,000	0	15 to 25	2013	50	14	A	SF	Y	3078	342

A02	Commerci	Public Asse	North Am	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2013	50	14	A	SF	Y	15876.62	341
A02	Commerci	Other	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2014	50	14	A	SF	Y	11404.75	341
A02	Commerci	Other	Middle Ea	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2013	50	14	A	SF	Y	5765.38	340
A02	Commerci	Lodging	North Am	New	46452 to 92903	500,001 to 1 million	0	15 to 25	2014	50	14	A	SF	Y	26376.67	336
A02	Commerci	Other	Middle Ea	New	Over 92903	Over 1 million	0	7 to 14	2014	50	14	A	SF	Y	134000	335
A02	Commerci	Other	Europe	New	4646 to 9290	50,001 to 100,000	0	7 to 14	2014	50	14	A	SF	Y	2109.88	329
A02	Residentia	Other	Asia-Pacifi	New	Over 92903	Over 1 million	0	More than	2013	50	14	A	SF	Y	71458.08	328
A02	Commerci	Other	North Am	New	18581 to 46451	200,001 to 500,000	0	More than	2014	50	14	A	SF	Y	13236.11	328
A02	Residentia	Other	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2014	50	14	A	SF	Y	785.89	328
A02	Commerci	Public Asse	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	50	14	A	SF	Y	2145.69	323
A02	Commerci	Public Asse	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2013	50	14	A	SF	Y	676.52	322
A02	Commerci	Office	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2014	50	14	A	SF	Y	29134.6	321
A02	Commerci	Mercantile		New	94 to 465	1,001 to 5,000	0	1 to 6	2015	50	14	A	SF	Y	107.48	318
A02	Commerci	Other	Asia-Pacifi	New	4646 to 9290	50,001 to 100,000	0	15 to 25	2013	50	14	A	SF	Y	2182.55	317
A02	Commerci	Public Asse	North Am	New	466 to 929	5,001 to 10,000	0	1 to 6	2013	50	14	A	SF	Y	255.82	317
A02	Residentia	Other	Asia-Pacifi	New	Over 92903	Over 1 million	0	More than	2014	50	14	A	SF	Y	50653.54	316
A02	Commerci	Mixed	Middle Ea	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2013	50	14	A	SF	Y	8241.6	313
A02	Commerci	Mixed	North Am	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2014	50	14	A	SF	Y	4377.51	310
A02	Commerci	Health Car	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2014	50	14	A	SF	Y	863.97	310
A02	Residentia	Other	North Am	New	18581 to 46451	200,001 to 500,000	0	More than	2013	50	14	A	SF	Y	13100.36	309
A02	Commerci	Public Asse	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2013	50	14	A	SF	Y	5681.58	309
A02	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	50	14	A	SF	Y	2697.7	304
A02	Commerci	Mercantile		New	94 to 465	1,001 to 5,000	0	More than	2015	50	14	A	SF	Y	50.7	300
A02	Commerci	Health Car	North Am	New	2324 to 4645	25,001 to 50,000	0	7 to 14	2014	50	14	A	SF	Y	1170.6	300
A02	Commerci	Public Asse	North Am	New	4646 to 9290	50,001 to 100,000	0	7 to 14	2014	50	14	A	SF	Y	2581.03	294
A02	Commerci	Mixed	North Am	New	46452 to 92903	500,001 to 1 million	0	More than	2014	50	14	A	SF	Y	21850.67	294
A02	Commerci	Other	Africa	New	Over 92903	Over 1 million	0	More than	2015	50	14	A	SF	Y	68620	292
A02	Residentia	Other	North Am	New	4646 to 9290	50,001 to 100,000	0	7 to 14	2013	50	14	A	SF	Y	2097.73	292
A02	Commerci	Other	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	50	14	A	SF	Y	1770.13	289
A02	Commerci	Health Car	North Am	New	46452 to 92903	500,001 to 1 million	0	1 to 6	2013	50	14	A	SF	Y	16901.46	286
A02	Commerci	Education	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2014	50	14	A	SF	Y	465.04	286
A02	Commerci	Education	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2015	50	14	A	SF	Y	972.69	286
A02	Commerci	Education	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2013	50	14	A	SF	Y	3971.48	285
A02	Commerci	Other	North Am	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2013	50	14	A	SF	Y	5226.05	285
A02	Commerci	Other	North Am	New	Over 92903	Over 1 million	0	More than	2014	50	14	A	SF	Y	35050.97	283
A02	Commerci	Education	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2014	50	14	A	SF	Y	450.4	277
A02	Commerci	Office	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2013	50	14	A	SF	Y	4137.24	276
A02	Commerci	Education	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2013	50	14	A	SF	Y	727.74	274
A02	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2014	50	14	A	SF	Y	1775.32	273
A02	Commerci	Other	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2013	50	14	A	SF	Y	3089.38	272
A02	Residentia	Other		New	94 to 465	1,001 to 5,000	0	1 to 6	2015	50	14	A	SF	Y	89.91	266
A02	Commerci	Other	North Am	New	Over 92903	Over 1 million	0	More than	2014	50	14	A	SF	Y	30890.05	266
A02	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2015	50	14	A	SF	Y	1359.26	266
A02	Commerci	Other	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2015	50	14	A	SF	Y	4451.83	264
A02	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	50	14	A	SF	Y	1799.68	262
A02	Commerci	Other	North Am	New	18581 to 46451	200,001 to 500,000	0	15 to 25	2014	50	14	A	SF	Y	9025.9	261
A02	Commerci	Mercantile		New	94 to 465	1,001 to 5,000	0	1 to 6	2015	50	14	A	SF	Y	87.88	260

A02	Residentia	Other	North Am	New	4646 to 9290	50,001 to 100,000	0	7 to 14	2013	50	14	A	SF	Y	1259.96	260
A02	Commerci	Mixed	North Am	New	46452 to 92903	500,001 to 1 million	0	More than	2013	50	14	A	SF	Y	22913.02	260
A02	Commerci	Other	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2014	50	14	A	SF	Y	14296.8	259
A02	Commerci	Other	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2015	50	14	A	SF	Y	6073.29	259
A02	Commerci	Public Ass	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2013	50	14	A	SF	Y	9587.54	258
A02	Commerci	Health Car	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2014	50	14	A	SF	Y	695.05	258
A02	Commerci	Other	North Am	New	46452 to 92903	500,001 to 1 million	0	More than	2015	50	14	A	SF	Y	14980.25	258
A02	Residentia	Other	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	More than	2013	50	14	A	SF	Y	15133.19	257
A02	Commerci	Other	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2013	50	14	A	SF	Y	6221.46	257
A02	Commerci	Other	North Am	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2013	50	14	A	SF	Y	18237.95	256
A02	Commerci	Health Car	North Am	New	Over 92903	Over 1 million	0	7 to 14	2013	50	14	A	SF	Y	30183.94	256
A02	Commerci	Health Car	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2015	50	14	A	SF	Y	248.63	255
A02	Commerci	Health Car	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2015	50	14	A	SF	Y	331.76	255
A02				New	94 to 465	1,001 to 5,000	0	1 to 6	2015	50	14	A	SF	Y	86.19	255
A02	Commerci	Public Ass	North Am	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2013	50	14	A	SF	Y	11825.99	254
A02	Commerci	Public Ass	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2014	50	14	A	SF	Y	3893.57	254
A02	Residentia	Other		New	94 to 465	1,001 to 5,000	0	1 to 6	2015	50	14	A	SF	Y	85.51	253
A02	Residentia	Other	North Am	New	18581 to 46451	200,001 to 500,000	0	More than	2014	50	14	A	SF	Y	10576.92	253
A02	Commerci	Education	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2013	50	14	A	SF	Y	666.79	252
A02	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	50	14	A	SF	Y	1211.87	252
A02	Commerci	Education	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2014	50	14	A	SF	Y	2740.75	252
A02	Commerci	Health Car	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2013	50	14	A	SF	Y	2933.94	251
A02	Commerci	Education	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2013	50	14	A	SF	Y	2472.81	248
A02	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	50	14	A	SF	Y	2124.2	247
A02	Commerci	Health Car	North Am	New	Over 92903	Over 1 million	0	More than	2013	50	14	A	SF	Y	29589.39	245
A02	Commerci	Public Ass	North Am	New	Over 92903	Over 1 million	0	More than	2014	50	14	A	SF	Y	28102.98	242
A02	Commerci	Public Ass	North Am	New	46452 to 92903	500,001 to 1 million	0	1 to 6	2013	50	14	A	SF	Y	11220.72	241
A02	Commerci	Public Ass	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2013	50	14	A	SF	Y	7803.84	240
A02	Commerci	Education	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2013	50	14	A	SF	Y	4543.05	237
A02	Residentia	Other	Asia-Pacifi	New	9291 to 18580	100,001 to 200,000	0	15 to 25	2015	50	14	A	SF	Y	4200.8	236
A02	Commerci	Health Car	North Am	New	46452 to 92903	500,001 to 1 million	0	15 to 25	2014	50	14	A	SF	Y	20920.64	235
A02				New	94 to 465	1,001 to 5,000	0	1 to 6	2015	50	14	A	SF	Y	78.75	233
A02	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	50	14	A	SF	Y	1713.55	232
A02	Commerci	Health Car	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2014	50	14	A	SF	Y	4635.25	231
A02	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2014	50	14	A	SF	Y	1159.43	230
A02	Commerci	Other	North Am	New	46452 to 92903	500,001 to 1 million	0	15 to 25	2014	50	14	A	SF	Y	14360.36	229
A02	Commerci	Office	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2014	50	14	A	SF	Y	6177.12	227
A02	Commerci	Health Car	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2013	50	14	A	SF	Y	4214.93	225
A02	Commerci	Other	North Am	New	Over 92903	Over 1 million	0	15 to 25	2014	50	14	A	SF	Y	25869.54	224
A02	Commerci	Public Ass	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2013	50	14	A	SF	Y	372.86	223
A02	Commerci	Education	North Am	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2015	50	14	A	SF	Y	2155.86	221
A02	Commerci	Education	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2013	50	14	A	SF	Y	634.26	220
A02	Commerci	Education	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2013	50	14	A	SF	Y	4888.56	213
A02	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2014	50	14	A	SF	Y	1637.36	211
A02	Commerci	Health Car	North Am	New	466 to 929	5,001 to 10,000	0	1 to 6	2014	50	14	A	SF	Y	117.53	211
A02	Commerci	Public Ass	North Am	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2013	50	14	A	SF	Y	9684.27	208
A02	Commerci	Lodging	North Am	New	18581 to 46451	200,001 to 500,000	0	15 to 25	2015	50	14	A	SF	Y	7826.88	207

A02	Residentia	Other	North Am	New	18581 to 46451	200,001 to 500,000	0	15 to 25	2013	50	14	A	SF	Y	4834	206
A02	Commerci	Other	Asia-Pacifi	New	46452 to 92903	500,001 to 1 million	0	1 to 6	2015	50	14	A	SF	Y	13413.83	203
A02	Commerci	Other	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2013	50	14	A	SF	Y	5498.26	203
A02	Residentia	Other	North Am	New	18581 to 46451	200,001 to 500,000	0	More than	2015	50	14	A	SF	Y	4481.7	201
A02	Residentia	Other		New	94 to 465	1,001 to 5,000	0	1 to 6	2015	50	14	A	SF	Y	67.6	200
A02	Commerci	Education	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2013	50	14	A	SF	Y	210.4	200
A02	Commerci	Education	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2014	50	14	A	SF	Y	2865.6	199
A02	Commerci	Public Ass	North Am	New	46452 to 92903	500,001 to 1 million	0	1 to 6	2014	50	14	A	SF	Y	12165.55	194
A02	Commerci	Health Car	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2014	50	14	A	SF	Y	1079.23	192
A02	Commerci	Health Car	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2014	50	14	A	SF	Y	8138.51	191
A02	Commerci	Education	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2013	50	14	A	SF	Y	269.14	189
A02	Residentia	Other	North Am	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2013	50	14	A	SF	Y	10909.18	184
A02	Commerci	Education	North Am	New	94 to 465	1,001 to 5,000	0	1 to 6	2013	50	14	A	SF	Y	44.71	181
A02	Commerci	Office	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2013	50	14	A	SF	Y	6147.41	178
A02	Commerci	Lodging	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2014	50	14	A	SF	Y	5130.52	177
A02	Commerci	Other	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2015	50	14	A	SF	Y	6398.73	177
A02	Commerci	Education	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2013	50	14	A	SF	Y	202.22	176
A02	Commerci	Mixed	North Am	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2014	50	14	A	SF	Y	10346.16	176
A02	Commerci	Other	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2015	50	14	A	SF	Y	4797.41	176
A02	Commerci	Education	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2014	50	14	A	SF	Y	4643.15	173
A02	Commerci	Other	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2014	50	14	A	SF	Y	5320.99	172
A02	Commerci	Education	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2013	50	14	A	SF	Y	1781.99	171
A02	Commerci	Public Ass	North Am	New	18581 to 46451	200,001 to 500,000	0	More than	2014	50	14	A	SF	Y	7943.12	171
A02	Commerci	Other	North Am	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2013	50	14	A	SF	Y	12674.09	168
A02	Commerci	Other	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2014	50	14	A	SF	Y	2130.24	168
A02	Commerci	Other	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2013	50	14	A	SF	Y	3753.33	167
A02	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2014	50	14	A	SF	Y	1064.15	157
A02	Commerci	Health Car	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2015	50	14	A	SF	Y	2152.8	155
A02	Commerci	Lodging	North Am	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2015	50	14	A	SF	Y	7234.91	153
A02	Commerci	Public Ass	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2014	50	14	A	SF	Y	885.95	149
A02	Commerci	Education	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2014	50	14	A	SF	Y	183.87	149
A02	Commerci	Education	North Am	New	466 to 929	5,001 to 10,000	0	1 to 6	2013	50	14	A	SF	Y	120.41	143
A02	Commerci	Public Ass	Africa	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2015	50	14	A	SF	Y	791.51	142
A02	Commerci	Other	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2013	50	14	A	SF	Y	2268	140
A02	Commerci	Education	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2013	50	14	A	SF	Y	132.39	134
A02	Commerci	Other	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2015	50	14	A	SF	Y	6177.98	133
A02	Commerci	Education	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2014	50	14	A	SF	Y	271.03	129
A02	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2015	50	14	A	SF	Y	761.09	128
A02	Commerci	Public Ass	North Am	New	466 to 929	5,001 to 10,000	0	1 to 6	2014	50	14	A	SF	Y	108.2	127
A02	Residentia	Other	North Am	New	46452 to 92903	500,001 to 1 million	0	15 to 25	2013	50	14	A	SF	Y	7966.73	126
A02	Commerci	Public Ass	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	50	14	A	SF	Y	1140.58	123
A02	Commerci	Other	North Am	New	4646 to 9290	50,001 to 100,000	0	7 to 14	2014	50	14	A	SF	Y	696.51	119
A02	Commerci	Health Car	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	50	14	A	SF	Y	985.89	118
A02	Commerci	Health Car	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2013	50	14	A	SF	Y	3804.37	117
A02	Generic	Other	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2014	50	14	A	SF	Y	460.21	112
A02	Residentia	Other	Asia-Pacifi	New	Over 92903	Over 1 million	0	15 to 25	2014	50	14	A	SF	Y	10599.06	111
A02	Commerci	Office	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2013	50	14	A	SF	Y	1184.83	109

A02	Commerci	Education	North Am	New	2324 to 4645	25,001 to 50,000	0	More than	2014	50	14	A	SF	Y	288.96	109
A02	Commerci	Office	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2013	50	14	A	SF	Y	360.19	106
A02	Commerci	Public Ass	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2014	50	14	A	SF	Y	2897.82	102
A02	Commerci	Education	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2013	50	14	A	SF	Y	1965.5	100
A02	Commerci	Public Ass	North Am	New	46452 to 92903	500,001 to 1 million	0	1 to 6	2014	50	14	A	SF	Y	6270.9	100
A02	Commerci	Office	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2013	50	14	A	SF	Y	1010.91	93
A02	Commerci	Education	North Am	New	466 to 929	5,001 to 10,000	0	1 to 6	2015	50	14	A	SF	Y	72.22	92
A02	Commerci	Other	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2014	50	14	A	SF	Y	2023.38	90
A03	Commerci	Other	North Am	New	466 to 929	5,001 to 10,000	0					A			600	
A03	Commerci	Education	North Am	New	930 to 2323	10,001 to 25,000	0					A			2100	
A03	Commerci	Other	Asia-Pacifi	Renovatio	466 to 929	5,001 to 10,000	0					A			100	
A03	Residentia	Other	North Am	New	2324 to 4645	25,001 to 50,000	0					A			1135	
A03	Commerci	Education	North Am	New	94 to 465	1,001 to 5,000	0					A			29	
A03	Commerci	Education	North Am	New	94 to 465	1,001 to 5,000	0					A			119	
A03	Commerci	Education	North Am	New	466 to 929	5,001 to 10,000	0					A			202	
A03	NonComm	Park	North Am	New	94 to 465	1,001 to 5,000	0					A			28	
A03	Commerci	Other	North Am	Renovatio	2324 to 4645	25,001 to 50,000	0					A			139	
A03	Commerci	Other	North Am	Renovatio	466 to 929	5,001 to 10,000	0					A			196	
A03	Commerci	Other	North Am	Renovatio	94 to 465	1,001 to 5,000	0					A			37	
A03	Residentia	Other	North Am	New	93 or less	1,000 or less	0					A			65	
A03	Commerci	Education	North Am	New	466 to 929	5,001 to 10,000	0					A			1387	
A03	Commerci	Education	North Am	New	930 to 2323	10,001 to 25,000	0					A			2600	
A03	Commerci	Education	North Am	New	94 to 465	1,001 to 5,000	0					A			268	
A03	Commerci	Education	North Am	New	930 to 2323	10,001 to 25,000	0					A			1234	
A03	Commerci	Education	North Am	New	94 to 465	1,001 to 5,000	0					A			50	
A04	Commerci	Public Ass	Africa	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2011	100		AB	SFEI	N	2417.88	1209.71
A04	Commerci	Office		New	2324 to 4645	25,001 to 50,000	0	1 to 6	2004			A	SFEI	N	3069.74	1058.53
A04				New	46452 to 92903	500,001 to 1 million	0	1 to 6	2011	120		AB	SFEI	N	39011.91	1057.23
A04	Residentia	Other		New	93 or less	1,000 or less	0	1 to 6		100		A	SEI	N	59.4	913.85
A04	Residentia	Other		New	93 or less	1,000 or less	0	1 to 6		100		A	SEI	N	58.19	895.23
A04	Residentia	Other		New	93 or less	1,000 or less	0	1 to 6		100		A	SEI	N	58.09	893.69
A04	Residentia	Other		New	93 or less	1,000 or less	0	1 to 6		100		A	SEI	N	55.95	860.77
A04	Commerci	Public Ass	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14		40		B	S	N	21425.09	801
A04	Commerci	Office		New	2324 to 4645	25,001 to 50,000	0	1 to 6	1998	60		A	S	N	2035.8	783
A04	Commerci	Office		New	2324 to 4645	25,001 to 50,000	0	1 to 6	1998	60		A	S	N	2025.4	779
A04	Commerci	Office		New	2324 to 4645	25,001 to 50,000	0	1 to 6	1998	60		A	S	N	2015	775
A04	Commerci	Office		New	2324 to 4645	25,001 to 50,000	0	1 to 6	1998	60		A	S	N	2004.6	771
A04	Commerci	Office	Europe	New	46452 to 92903	500,001 to 1 million	0	More than	2010	50		AB	SFEI	N	64791.35	762.25
A04	Commerci	Office		New	2324 to 4645	25,001 to 50,000	0	1 to 6	1998	60		A	S	N	1970.8	758
A04	Commerci	Office		New	2324 to 4645	25,001 to 50,000	0	1 to 6	1998	60		A	S	N	1960.4	754
A04	Residentia	Other		New	2324 to 4645	25,001 to 50,000	0	7 to 14	2010	60		A	S	N		751.83
A04	Commerci	Office	Middle Ea	New	Over 92903	Over 1 million	0	More than	2010	60		AB	SFEI	N	55752.78	747.72
A04	Commerci	Office		New	2324 to 4645	25,001 to 50,000	0	1 to 6	1998	60		A	S	N	1937	745
A04	Commerci	Office		New	2324 to 4645	25,001 to 50,000	0	1 to 6	1998	60		A	S	N	1931.8	743
A04	Commerci	Office		New	2324 to 4645	25,001 to 50,000	0	1 to 6	1998	60		A	S	N	1926.6	741
A04	Commerci	Office		New	2324 to 4645	25,001 to 50,000	0	1 to 6	1998	60		A	S	N	1921.4	739
A04	Commerci	Office		New	2324 to 4645	25,001 to 50,000	0	7 to 14	2010	60		A	S	N		716.32

A04	Commerci	Office		New	2324 to 4645	25,001 to 50,000	0	1 to 6	2004		A	SFEI	N	1703.45	708
A04	Commerci	Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	1998		A	S	N	11880	660
A04	NonComm	Other		New	9291 to 18580	100,001 to 200,000	0	7 to 14	2010	50	AB	SFEI	N	9022.05	659.8
A04			Europe	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2010	50	AB	SFEI	N	14888.94	645.1
A04	Commerci	Office	Europe	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2010	60	AB	SFEI	N	17442.36	638.54
A04	Commerci	Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	1998		A	S	N	11448	636
A04	Commerci	Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	1998		A	S	N	11430	635
A04	Commerci	Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	1998		A	S	N	11286	627
A04	Commerci	Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	1998		A	S	N	11088	616
A04	Residentia	Other		New	466 to 929	5,001 to 10,000	0	1 to 6	2004		A	SFEI	N	285.22	603
A04	Commerci	Education		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		B	SFEI	N	7071000	590.94
A04	Residentia	Other		New	93 or less	1,000 or less	0	1 to 6			A	SEI	N	36.96	568.62
A04	Industrial	Industrial	Europe	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2010	60	AB	SFEI	N	1442.3	565.61
A04	Commerci	Education		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2010		AB	S	N	5532.47	563.88
A04	Commerci	Health Care		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		B	SFEI	N	5147000	557.57
A04	Commerci	Office	Europe	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2010	40	AB	SFEI	N	1199.16	556.13
A04	Commerci	Office	Europe	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2010	60	AB	SFEI	N	8285.94	552.4
A04	Commerci	Health Car	Europe	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2010	60	AB	SFEI	N	8090.74	546.67
A04	Residentia	Other		New	466 to 929	5,001 to 10,000	0	1 to 6	2004		A	SFEI	N	366.79	539.4
A04	Residentia	Other		New	93 or less	1,000 or less	0	1 to 6			A	SEI	N	35.05	539.23
A04	Residentia	Other		New	93 or less	1,000 or less	0	1 to 6			A	SEI	N	33.27	511.85
A04	Commerci	Health Care		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		B	SFEI	N	4504000	502.58
A04	Commerci	Office	Europe	New	46452 to 92903	500,001 to 1 million	0	15 to 25	2010	50	AB	SFEI	N	39869.98	493.44
A04	Residentia	Other		New	93 or less	1,000 or less	0	1 to 6			A	SEI	N	32.03	492.77
A04	Commerci	Office		New	4646 to 9290	50,001 to 100,000	0	1 to 6	2004		A	SFEI	N	2952.25	490
A04	Commerci	Health Care		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		B	SFEI	N	4284000	476.98
A04	Commerci	Office	Asia-Pacifi	New	2324 to 4645	25,001 to 50,000	0	7 to 14	2008	60	A	SFEI	N	1674	470
A04	Commerci	Education		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		B	SFEI	N	5382000	461.89
A04	Commerci	Education		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		B	SFEI	N	5289000	456.93
A04	Commerci	Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	2009		B	SFEI	N	6810000	455.28
A04	Commerci	Office	Europe	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2010	40	AB	SFEI	N	1039.86	453.53
A04	Commerci	Education		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		B	SFEI	N	5202000	451.95
A04	Commerci	Education		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		B	SFEI	N	5188000	451.54
A04	Commerci	Health Care		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		B	SFEI	N	3942000	450.3
A04	Commerci	Education		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		B	SFEI	N	5187000	448.01
A04	Commerci	Health Care		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		B	SFEI	N	3888000	447.35
A04	Commerci	Warehouse		New	46452 to 92903	500,001 to 1 million	0	1 to 6	2008	25	A	SFEI	N	21060	442
A04	Commerci	Health Care		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		B	SFEI	N	3881000	438.12
A04	Commerci	Office	Asia-Pacifi	New	2324 to 4645	25,001 to 50,000	0	7 to 14	2008	60	A	SFEI	N	1528	430
A04	Commerci	Office	Asia-Pacifi	New	2324 to 4645	25,001 to 50,000	0	7 to 14	2008	60	A	SFEI	N	1491	420
A04	Commerci	Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	2009		B	SFEI	N	6112000	415.95
A04	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2010		A	SF	N	1088.62	411
A04	Commerci	Office	Asia-Pacifi	New	2324 to 4645	25,001 to 50,000	0	7 to 14	2008	60	A	SFEI	N	1451	410
A04	Commerci	Office	Europe	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2010	40	AB	SFEI	N	2190.82	400.14
A04	Commerci	Education	Europe	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2010	50	AB	SFEI	N	5785.47	399
A04	Commerci	Office	Europe	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2010	30	AB	SFEI	N	2425.74	398.45
A04	Commerci	Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	2009		B	SFEI	N	5699000	389.39

A04	Commerci	Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	2009		B	SFEI	N	5682000	384.99
A04	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2010		A	SF	N	1035.55	381
A04	Commerci	Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	2009		B	SFEI	N	5442000	373.09
A04	Commerci	Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	2009		B	SFEI	N	5317000	362.42
A04	Commerci	Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	2009		B	SFEI	N	5184000	357.71
A04	Residentia	Other	Europe	New	466 to 929	5,001 to 10,000	0	1 to 6	2010	40	AB	SFEI	N	194.51	353.39
A04	Commerci	Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	2009		B	SFEI	N	5069000	353.14
A04	Commerci	Warehouse		New	46452 to 92903	500,001 to 1 million	0	1 to 6	2008	30	D	SFEI	N	19211	350
A04	Residentia	Other	Europe	New	4646 to 9290	50,001 to 100,000	0	7 to 14	2010	50	AB	SFEI	N	2836.21	321.79
A04	Residentia	Other		New	2324 to 4645	25,001 to 50,000	0	7 to 14	2011	60	AB	SFEI	N	929.62	320.24
A04	Commerci	Office	Asia-Pacifi	New	2324 to 4645	25,001 to 50,000	0	7 to 14	2008	60	B	SFEI	N	1245	320
A04	Residentia	Other		New	93 or less	1,000 or less	0	1 to 6	2009	60	A	SEI	N	21.44	318.5
A04	Residentia	Other		New	93 or less	1,000 or less	0	1 to 6	2009	60	A	SEI	N	20.21	318.24
A04				New	18581 to 46451	200,001 to 500,000	0	1 to 6	2010	40	AB	S	N	6360.39	318.02
A04	Commerci	Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	2009		A	S	N	5184000	315
A04	Commerci	Office	Europe	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2002	50	BCD	SFEI	N	4818	309
A04	Commerci	Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	2009		A	S	N	5069000	308
A04	Commerci	Office	Asia-Pacifi	New	2324 to 4645	25,001 to 50,000	0	7 to 14	2008	60	A	SFEI	N	1021	290
A04	Residentia	Other		New	93 or less	1,000 or less	0	1 to 6	2009	60	A	SEI	N	20.48	280.59
A04	Commerci	Office	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2012	60	BCD	SFEI	N	1743	274.23
A04	NonComm	Parking	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2009		A	Other	N	265	273.82
A04	Residentia	Other		New	93 or less	1,000 or less	0	1 to 6	2009	60	A	SEI	N	23.85	268.52
A04	Residentia	Other		New	94 to 465	1,001 to 5,000	0	1 to 6	2009	60	A	SEI	N	44.07	267.09
A04	Residentia	Other		New	94 to 465	1,001 to 5,000	0	1 to 6	2009	60	A	SEI	N	27.68	266.19
A04	Residentia	Other		New	94 to 465	1,001 to 5,000	0	1 to 6	2009	60	A	SEI	N	39.32	264.6
A04	Residentia	Other	Europe	New	4646 to 9290	50,001 to 100,000	0	7 to 14		50	AB	SFEI	N	2303.42	261.34
A04	Commerci	Office	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2012	60	BCD	SFEI	N	1678	259.35
A04	Commerci	Education	North Am	New	46452 to 92903	500,001 to 1 million	0	1 to 6	2009		A	SF	N	6818.4	259
A04	Residentia	Other		New	93 or less	1,000 or less	0	1 to 6	2009	60	A	SEI	N	20.04	254.28
A04	Commerci	Education	North Am	New	46452 to 92903	500,001 to 1 million	0	1 to 6	2009		A	SF	N	4889.72	254
A04	Residentia	Other		New	93 or less	1,000 or less	0	1 to 6	2009	60	A	SEI	N	22.77	253.54
A04	Residentia	Other		New	93 or less	1,000 or less	0	1 to 6	2009	60	A	SEI	N	22.57	251.3
A04	Commerci	Education		New	4646 to 9290	50,001 to 100,000	0	1 to 6	2011	60	AB	SFEI	N	1875.47	245.92
A04	NonComm	Parking	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2009		A	Other	N	237	244.88
A04	Residentia	Other		New	93 or less	1,000 or less	0	1 to 6	2009	60	A	SEI	N	15.52	244.38
A04	Residentia	Other		New	93 or less	1,000 or less	0	1 to 6	2009	60	A	SEI	N	16.4	243.66
A04	Commerci	Office	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011	60	CD	SF	N	10978.08	237
A04	Commerci	Office	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011	60	CD	SFE	N	9495.81	237
A04	Commerci	Office	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011	60	CD	SF	N	10978.08	237
A04	Commerci	Office	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011	60	CD	SFE	N	9449.48	237
A04	Commerci	Office	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011	60	CD	Other	N	9264.2	232
A04	Commerci	Office	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011	60	CD	Other	N	9217.88	232
A04	Commerci	Office	North Am	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2011	60	CD	SFE	N	9454.12	229.89
A04	Commerci	Office	North Am	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2011	60	CD	SFE	N	9408.01	229.89
A04	Residentia	Other		New	94 to 465	1,001 to 5,000	0	1 to 6	2009	60	A	SEI	N	25.28	227.73
A04	Residentia	Other		New	93 or less	1,000 or less	0	1 to 6	2009	60	A	SEI	N	17.84	226.43
A04	Commerci	Office	North Am	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2011	60	CD	Other	N	9221.63	225

A04	Commerci Office	North Am	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2011	60	CD	Other	N	9032.88	222
A04	Commerci Public Ass	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2008		A	SEI	N	386.91	209.14
A04			New			0	1 to 6			A	S	N		200
A04	Residentia Other		New	93 or less	1,000 or less	0	1 to 6	2009	60	A	SEI	N	14.07	192.79
A04	Commerci Office	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011	60	CD	SFE	N	9495.81	192
A04	Commerci Office	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011	60	CD	SF	N	8847.31	191
A04	Commerci Office	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011	60	CD	SFE	N	9495.81	191
A04	Commerci Office	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011	60	CD	SF	N	8847.31	191
A04	Commerci Office	North Am	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2011	60	CD	SFE	N	9454.12	186.24
A04	Commerci Office	North Am	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2011	60	CD	SFE	N	9454.12	185.27
A04	Residentia Other		New	93 or less	1,000 or less	0	1 to 6	2009	60	A	SEI	N	16.31	183.66
A04	Commerci Office	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011	60	CD	SFE	N	9125.24	183
A04	Commerci Office	North Am	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2011	60	CD	Other	N	9078.92	183
A04	Residentia Other		New	94 to 465	1,001 to 5,000	0	1 to 6	2009	60	A	SEI	N	18.84	181.12
A04	Commerci Office	North Am	New	4646 to 9290	50,001 to 100,000	0	7 to 14	2011	60	BD	SFEI	N	1720.39	181.06
A04	Commerci Office	North Am	New	4646 to 9290	50,001 to 100,000	0	7 to 14	2011	60	BD	SFEI	N	1697.02	178.54
A04	Commerci Office	North Am	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2011	60	CD	Other	N	9060.94	177
A04	Commerci Office	North Am	New	46452 to 92903	500,001 to 1 million	0	7 to 14	2011	60	CD	Other	N	9014.82	177
A04	Residentia Other		New	94 to 465	1,001 to 5,000	0	1 to 6	2009	60	A	SEI	N	26.26	176.72
A04	Commerci Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2009		A	S	N	935	175.05
A04	Residentia Other	North Am	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	CD	SFE	N	75.5	172
A04	Commerci Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2009		A	S	N	905	169.44
A04	Residentia Other	North Am	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	CD	SFE	N	69.24	156
A04	Commerci Office	North Am	New	4646 to 9290	50,001 to 100,000	0	7 to 14	2011	60	BD	SFEI	N	1379.55	150.23
A04	Residentia Other	North Am	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	CD	Other	N	87.14	149
A04	Residentia Other	North Am	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	CD	Other	N	70.37	149
A04	Commerci Education	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		A	S	N	2300	144
A04	Commerci Education	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2009		A	Other	N	5216	142.05
A04	Commerci Office	North Am	New	4646 to 9290	50,001 to 100,000	0	7 to 14	2011	60	BD	SFEI	N	1305.56	141.59
A04	Commerci Education	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2009		A	Other	N	5175	140.94
A04	Residentia Other	North Am	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	CD	Other	N	65.23	138
A04	Commerci Office	North Am	New	4646 to 9290	50,001 to 100,000	0	7 to 14	2011	60	BD	SFEI	N	1264.27	136.97
A04	Residentia Other	North Am	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	CD	SFE	N	66.87	133
A04	Commerci Office	Asia-Pacifi	New	2324 to 4645	25,001 to 50,000	0	7 to 14	2008	60	A	SFEI	N	446	130
A04	Commerci Public Ass	North Am	New	930 to 2323	10,001 to 25,000	0	1 to 6	2008		A	SEI	N	240.45	129.98
A04	Residentia Other	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2011	60	CD	SFE	N	544.21	124
A04	Residentia Other	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2011	60	CD	SFE	N	538	122
A04	Residentia Other	North Am	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	CD	Other	N	77.12	119
A04	Residentia Other	North Am	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	CD	Other	N	63.75	119
A04	Residentia Other	North Am	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	CD	SFE	N	75.86	115.24
A04	Residentia Other	North Am	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	CD	SFE	N	60.62	114
A04	Residentia Other	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2011	60	CD	Other	N	500.29	110
A04	Residentia Other	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2011	60	CD	Other	N	497.21	109
A04	Commerci Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	2006	30		SF	N	1264	108
A04	Residentia Other	North Am	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	CD	Other	N	58.84	106
A04	Residentia Other	North Am	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	CD	SFE	N	67.13	89.11
A04	Residentia Other	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2011	60	CD	SFE	N	427.6	87.4

A04	Residentia Other	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2011	60	CD	SFE	N	412.3	84
A04	Commerci Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	2006	30		SF	N	963	82
A04	Residentia Other	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2011	60	CD	Other	N	410.66	82
A04	Residentia Other	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2011	60	CD	Other	N	399.75	80
A04	Commerci Office	Asia-Pacifi	New	2324 to 4645	25,001 to 50,000	0	7 to 14	2008	60	A	SFEI	N	245	70
A04	Commerci Office	North Am	New	4646 to 9290	50,001 to 100,000	0	7 to 14	2011	60	BD	SFEI	N	2438	
A04	Commerci Office	North Am	New	4646 to 9290	50,001 to 100,000	0	7 to 14	2011	60	BD	SFEI	N	1556	
A04	Residentia Other	Asia-Pacifi	New	94 to 465	1,001 to 5,000	0	1 to 6	2005	35	BCD	SFEI	N	70	
A04	Residentia Other	Asia-Pacifi	New	94 to 465	1,001 to 5,000	0	1 to 6	2005	35	BCD	SFEI	N	7	
A04	Commerci Office	Asia-Pacifi	New	930 to 2323	10,001 to 25,000	0	7 to 14	1998	40	C	SFEI	N	1164980	
A04	Commerci Office	Asia-Pacifi	New	930 to 2323	10,001 to 25,000	0	7 to 14	1998	40	C	SFEI	N	856.44	
A04	Commerci Office	Asia-Pacifi	New	930 to 2323	10,001 to 25,000	0	7 to 14	1998	40	C	SFEI	N	1067.78	
A04	Commerci Office	Asia-Pacifi	New	930 to 2323	10,001 to 25,000	0	7 to 14	1998	40	C	SFEI	N	1168.64	
A04	Commerci Office	Asia-Pacifi	New	930 to 2323	10,001 to 25,000	0	7 to 14	1998	40	C	SFEI	N	927.22	
A04	Commerci Office	Asia-Pacifi	New	930 to 2323	10,001 to 25,000	0	7 to 14	1998	40	C	SFEI	N	1493.8	
A04	Commerci Office	Asia-Pacifi	New	4646 to 9290	50,001 to 100,000	0	7 to 14	1998	40	C	SFEI	N	6681.82	
A04	Commerci Office	Asia-Pacifi	New	18581 to 46451	200,001 to 500,000	0	7 to 14	1998	40	C	SFEI	N	17925.96	
A04	Commerci Office	Asia-Pacifi	New	930 to 2323	10,001 to 25,000	0	7 to 14	1998	40	C	SFEI	N	1098.8	
A04	Commerci Office	Asia-Pacifi	New	930 to 2323	10,001 to 25,000	0	7 to 14	1998	40	C	SFEI	N	1226.45	
A04	NonComm Parking	Middle Ea	New	Over 92903	Over 1 million	0	7 to 14	2003		AB	SF	N	35300	
A04	NonComm Parking	Middle Ea	New	Over 92903	Over 1 million	0	7 to 14	2003		AB	SF	N	32500	
A04	Commerci Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	2009		A	S	N	5317000	
A04	Commerci Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	2009		A	S	N	5317000	
A04	Commerci Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	2009		A	S	N	5184000	
A04	Commerci Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	2009		A	S	N	5069000	
A04	Commerci Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	2009		A	S	N	5682000	
A04	Commerci Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	2009		A	S	N	5682000	
A04	Commerci Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	2009		A	S	N	6112000	
A04	Commerci Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	2009		A	S	N	6112000	
A04	Commerci Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	2009		A	S	N	5442000	
A04	Commerci Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	2009		A	S	N	5442000	
A04	Commerci Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	2009		A	S	N	6810000	
A04	Commerci Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	2009		A	S	N	6810000	
A04	Commerci Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	2009		A	S	N	5699000	
A04	Commerci Office		New	9291 to 18580	100,001 to 200,000	0	7 to 14	2009		A	S	N	5699000	
A04	Commerci Health Care		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		A	S	N	4284000	
A04	Commerci Health Care		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		A	S	N	4284000	
A04	Commerci Health Care		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		A	S	N	3942000	
A04	Commerci Health Care		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		A	S	N	3942000	
A04	Commerci Health Care		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		A	S	N	3888000	
A04	Commerci Health Care		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		A	S	N	3888000	
A04	Commerci Health Care		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		A	S	N	3881000	
A04	Commerci Health Care		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		A	S	N	3881000	
A04	Commerci Health Care		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		A	S	N	5147000	
A04	Commerci Health Care		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		A	S	N	5147000	
A04	Commerci Health Care		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		A	S	N	4504000	
A04	Commerci Health Care		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		A	S	N	4504000	

A04	Commerci	Education		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		A	S	N	5382000	
A04	Commerci	Education		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		A	S	N	5382000	
A04	Commerci	Education		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		A	S	N	5289000	
A04	Commerci	Education		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		A	S	N	5289000	
A04	Commerci	Education		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		A	S	N	5188000	
A04	Commerci	Education		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		A	S	N	5188000	
A04	Commerci	Education		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		A	S	N	5187000	
A04	Commerci	Education		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		A	S	N	5187000	
A04	Commerci	Education		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		A	S	N	7071000	
A04	Commerci	Education		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		A	S	N	7071000	
A04	Commerci	Education		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		A	S	N	5202000	
A04	Commerci	Education		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		A	S	N	5202000	
A04	Commerci	Warehouse		New	18581 to 46451	200,001 to 500,000	0	1 to 6	2010		BD	S	N	8257	
A04	Commerci	Warehouse		New	18581 to 46451	200,001 to 500,000	0	1 to 6	2010		BD	S	N	9388	
A04	Commerci	Warehouse		New	18581 to 46451	200,001 to 500,000	0	1 to 6	2010		BD	S	N	8846	
A04	Commerci	Education		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2010	40	BD	SFEI	N	2981	
A04	Commerci	Education		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2010		BD	SFEI	N	3315	
A04	Commerci	Education		New	9291 to 18580	100,001 to 200,000	0	1 to 6	2010		BD	Other	N	2897	
A04	Commerci	Health Car	North Am	New	46452 to 92903	500,001 to 1 million	0	7 to 14				SF	N	3395	
A04	Commerci	Education	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2009		A	S	N	215	
A04	Commerci	Education		New	2324 to 4645	25,001 to 50,000	0	1 to 6	2007			Other	N	1470.43	
A05	Commerci	Office	North Am	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	504502	570.78
A05	Commerci	Office	North Am	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	504502	570.78
A05	Commerci	Office	North Am	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	456900.8	530.19
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	444774.4	516.61
A05	Commerci	Office	North Am	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	444001.5	515.1
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	431876	501.51
A05	Commerci	Office	North Am	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	435526.5	495.58
A05	Commerci	Office	North Am	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	447630.2	494.23
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	433341.1	491.04
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	433341.1	491.04
A05	Commerci	Office	North Am	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	423449.1	481.45
A05	Commerci	Office	North Am	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	415028.5	472.66
A05	Commerci	Office	North Am	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	415028.5	472.66
A05	Commerci	Office	North Am	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	415084.8	459.71
A05	Commerci	Office	North Am	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	407099.7	459.24
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	378121.3	431.26
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	373397.6	426.01
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	373397.6	426.01
A05	Commerci	Office	North Am	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	383532.7	422.81
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	366045.7	417.13
A05	Commerci	Office	North Am	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	359760.7	405.79
A05	Commerci	Office	North Am	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	351500.7	400.34
A05	Commerci	Office	North Am	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	113534.8	398.5
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	360081	396.13
A05	Commerci	Office	North Am	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	346373.3	382.75
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	338701.2	382.61

A05	Commerci	Office	North Ame	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	331499.9	377.99
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	336864.1	372.07
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	311878.3	355.95
A05	Commerci	Office	North Ame	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	100934.9	354.42
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	313439.6	353.89
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	296765.4	339.07
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	308578.9	338.83
A05	Commerci	Office	North Ame	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	97620.9	337.92
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	96049.65	336.76
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	280747.2	309.22
A05	Commerci	Office	North Ame	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	84224.43	307.52
A05	Commerci	Office	North Ame	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	85401.05	306.63
A05	Commerci	Office	North Ame	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	84863.09	304.65
A05	Commerci	Office	North Ame	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	84345.99	301.89
A05	Commerci	Office	North Ame	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	82782.9	299.72
A05	Commerci	Office	North Ame	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	84989.19	294.99
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	80099.43	292.96
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	81406.69	285.46
A05	Commerci	Office	North Ame	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	78256.02	285.46
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	77669.07	281.66
A05	Commerci	Office	North Ame	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	76821.76	280.2
A05	Commerci	Office	North Ame	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	75848.34	276.56
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	75966.28	273.31
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	75430.13	271.33
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	74130.12	270.89
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	74334.24	266.54
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	72695.86	265.63
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	76928.8	264.85
A05	Commerci	Office	North Ame	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	72967.11	263.09
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	71723.35	262
A05	Commerci	Office	North Ame	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	71614.49	258.18
A05	Commerci	Office	North Ame	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	70359.84	253.55
A05	Commerci	Office	North Ame	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	70416.09	253.19
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	66282.93	239.49
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	65787.6	237.61
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	67442.32	233.13
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	64532.05	232.97
A05	Commerci	Office	Europe	New	Over 92903	Over 1 million	0	More than	2015	100	ABCD	S	Y	64337.91	231.73
A05	NonComm	Public Ass	North Ame	New	94 to 465	1,001 to 5,000	0	1 to 6	2009		A	SFEI	Y	170	
A05	NonComm	Public Ass	North Ame	New	94 to 465	1,001 to 5,000	0	1 to 6	2009		A	SFEI	Y	212	
A05	NonComm	Public Ord	North Ame	New	94 to 465	1,001 to 5,000	0	1 to 6	2009		A	SFEI	Y	279	
A05	NonComm	Public Ord	North Ame	New	94 to 465	1,001 to 5,000	0	1 to 6	2009		A	SFEI	Y	362	
A05	Residentia	Multi-fami	Asia-Pacifi	New	2324 to 4645	25,001 to 50,000	0			100	ABCD	SFEI	N	11651	2464.99
A05	Residentia	Multi-fami	Asia-Pacifi	New	2324 to 4645	25,001 to 50,000	0			100	ABCD	SFEI	N	11651	2464.99
A05	Residentia	Multi-fami	Asia-Pacifi	New	2324 to 4645	25,001 to 50,000	0			100	ABCD	SFEI	N	11651	2464.99
A05	Residentia	Multi-fami	Asia-Pacifi	New	2324 to 4645	25,001 to 50,000	0			100	ABCD	SFEI	N	11651	2464.99
A05	Residentia	Multi-fami	Asia-Pacifi	New	2324 to 4645	25,001 to 50,000	0			100	ABCD	SFEI	N	11651	2464.99

A05	Residentia	Multi-fami	Asia-Pacifi	New	2324 to 4645	25,001 to 50,000	0		100	ABCD	SFEI	N	11651	2464.99
A05	Residential		Europe	New	93 or less	1,000 or less	0		70	AB		N	84.22	1108.21
A05	Residential		Europe	New	93 or less	1,000 or less	0		70	AB		N	84.22	1108.21
A05	Residential		Europe	New	93 or less	1,000 or less	0		70	AB		N	84.22	1108.21
A05	Commerci	Education	Asia-Pacifi	New	466 to 929	5,001 to 10,000	0 1 to 6	2014	60	ABCD	SFEI	Y	419.73	443.2
A05	Residentia	Single-fam	Asia-Pacifi	New			0	2010	50	A			199	
A05	Commerci	Mixed	North Am	New	930 to 2323	10,001 to 25,000	0 1 to 6	2012	75	ABCD	SFEI	Y	3273.18	210.63
A05	Commerci	Office	North Am	New	18581 to 46451	200,001 to 500,000	0 15 to 25	2012	75	ABCD	SFEI	Y	32026.61	172.53
A05	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0 1 to 6	2012	75	ABCD	SFEI	Y	3369.74	156.25
A05	Commerci	Office	North Am	Renovatio	9291 to 18580	100,001 to 200,000	0 1 to 6	2012	75	ABCD	SFEI	Y	9837.12	118.51
A05	Commerci	Education	North Am	Renovatio	4646 to 9290	50,001 to 100,000	0 1 to 6	2012	75	ABCD	SFEI	Y	8084.08	98.78
A05	Residentia	Multi-fami	North Am	New	9291 to 18580	100,001 to 200,000	0 7 to 14	2012	75	ABCD	SFEI	Y	9162.43	88.54
A05	Residentia	Multi-fami	North Am	Renovatio	18581 to 46451	200,001 to 500,000	0 7 to 14	2012	75	ABCD	SFEI	Y	10944.1	83.78
A05	Residentia	Single-fam	North Am	New	94 to 465	1,001 to 5,000	0 1 to 6	2012	75	ABCD	SFEI	Y	125.66	75.26
A05	Commerci	Mixed	North Am	Renovatio	930 to 2323	10,001 to 25,000	0 1 to 6	2012	75	ABCD	SFEI	Y	949.39	51.45
A05	Commerci	Office	North Am	Renovatio	9291 to 18580	100,001 to 200,000	0 15 to 25	2012	75	ABCD	SFEI	Y	4181.52	49.88
A05	Residentia	Multi-fami	North Am	Renovatio	4646 to 9290	50,001 to 100,000	0 1 to 6	2012	75	ABCD	SFEI	Y	1990.24	42.47
A05	Residentia	Single-fam	North Am	Renovatio	94 to 465	1,001 to 5,000	0 1 to 6	2012	75	ABCD	SFEI	Y	46.29	32.21
A05	Commerci	Mixed			18581 to 46451	200,001 to 500,000	0 15 to 25						261	609
A05	Commerci	Mixed			9291 to 18580	100,001 to 200,000	0 7 to 14						385	297
A05	Commerci	Mixed			18581 to 46451	200,001 to 500,000	0 1 to 6						730	260
A05	Commerci	Mixed			9291 to 18580	100,001 to 200,000	0 1 to 6						249	217
A05	Commerci	Mixed			9291 to 18580	100,001 to 200,000	0 15 to 25						333	209
A05	Commerci	Office			18581 to 46451	200,001 to 500,000	0 15 to 25						724	205
A05	Commerci	Multi-family			18581 to 46451	200,001 to 500,000	0 7 to 14						4.56	164
A05	Residentia	Multi-fami	Asia-Pacific		4646 to 9290	50,001 to 100,000	0 7 to 14	2015	60	ABCD	SFEI	Y	4056524	536.4
A05	Residentia	Multi-fami	Asia-Pacific		4646 to 9290	50,001 to 100,000	0 1 to 6	2015	60	ABCD	SFEI	Y	2030862	383.5
A05	Commerci	Office	Middle Ea	New	Over 92903	Over 1 million	0 More than	2015	20	ABC	SFE	Y	197989.9	579.01
A05	Commerci	Public Ass	North Am	New	2324 to 4645	25,001 to 50,000	0 1 to 6	2015	20	ABC	SFEI	Y	1265.49	397.33
A05	Residentia	Single-fam	North Am	New	94 to 465	1,001 to 5,000	0 1 to 6	2004		A	SFEI	Y	46826000	244.31
A05	Residentia	Single-fam	North Am	New	94 to 465	1,001 to 5,000	0 1 to 6	2004		A	SFEI	Y	37047000	193.29
A05	Residentia	Single-fam	North Am	New	94 to 465	1,001 to 5,000	0 1 to 6	2004		A	SFEI	Y	28004000	139.93
A05	Residentia	Single-fam	North Am	New	94 to 465	1,001 to 5,000	0 1 to 6	2004		A	SFEI	Y	21367000	106.77
A05	Residentia	Multi-fami	North Am	New	2324 to 4645	25,001 to 50,000	0 1 to 6	2013	60	ABC	SEI		714283	154.01
A05	Residentia	Multi-fami	North Am	New	2324 to 4645	25,001 to 50,000	0 1 to 6	2013	60	ABC	SEI	Y	431470	84.58
A05	Residentia	Other	North Am	New	94 to 465	1,001 to 5,000	0 1 to 6	2011	60	ABC	SEI	N	40	266.67
A05	Residentia	Other	North Am	New	94 to 465	1,001 to 5,000	0 1 to 6	2011	60	ABC	SEI	N	28.4	258.18
A05	Residentia	Other	North Am	New	94 to 465	1,001 to 5,000	0 1 to 6	2011	60	ABC	SEI	N	25.8	258
A05	Residentia	Other	North Am	New	94 to 465	1,001 to 5,000	0 1 to 6	2011	60	ABC	SEI	N	38.4	256
A05	Residentia	Other	North Am	New	94 to 465	1,001 to 5,000	0 1 to 6	2011	60	ABC	SEI	N	43.1	253.53
A05	Residentia	Other	North Am	New	94 to 465	1,001 to 5,000	0 1 to 6	2011	60	ABC	SEI	N	27.6	250.91
A05	Residentia	Other	North Am	New	94 to 465	1,001 to 5,000	0 1 to 6	2011	60	ABC	SEI	N	39.7	248.13
A05	Residentia	Other	North Am	New	94 to 465	1,001 to 5,000	0 1 to 6	2011	60	ABC	SEI	N	39.3	245.63
A05	Residentia	Other	North Am	New	94 to 465	1,001 to 5,000	0 1 to 6	2011	60	ABC	SEI	N	45.6	240
A05	Residentia	Other	North Am	New	94 to 465	1,001 to 5,000	0 1 to 6	2011	60	ABC	SEI	N	30.7	236.15
A05	Residentia	Other	North Am	New	94 to 465	1,001 to 5,000	0 1 to 6	2011	60	ABC	SEI	N	23.3	233
A05	Residentia	Other	North Am	New	94 to 465	1,001 to 5,000	0 1 to 6	2011	60	ABC	SEI	N	25.6	232.73

A05	Residentia	Other	North Ame	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	ABC	SEI	N	34.4	229.33
A05	Residentia	Other	North Ame	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	ABC	SEI	N	25.1	228.18
A05	Residentia	Other	North Ame	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	ABC	SEI	N	24.8	225.45
A05	Residentia	Other	North Ame	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	ABC	SEI	N	29.2	224.62
A05	Residentia	Other	North Ame	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	ABC	SEI	N	35.6	222.5
A05	Residentia	Other	North Ame	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	ABC	SEI	N	34.9	218.13
A05	Residentia	Other	North Ame	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	ABC	SEI	N	27.6	212.31
A05	Residentia	Other	North Ame	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	ABC	SEI	N	42	210
A05	Residentia	Other	North Ame	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	ABC	SEI	N	22.5	204.55
A05	Residentia	Other	North Ame	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	ABC	SEI	N	42.9	204.29
A05	Residentia	Other	North Ame	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	ABC	SEI	N	26.3	202.31
A05	Residentia	Other	North Ame	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	ABC	SEI	N	30.2	201.33
A05	Residentia	Other	North Ame	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	ABC	SEI	N	29.8	198.67
A05	Residentia	Other	North Ame	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	ABC	SEI	N	27.4	195.71
A05	Residentia	Other	North Ame	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	ABC	SEI	N	31.2	195
A05	Residentia	Other	North Ame	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	ABC	SEI	N	27.3	182
A05	Residentia	Other	North Ame	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	ABC	SEI	N	26.7	178
A05	Residentia	Other	North Ame	New	94 to 465	1,001 to 5,000	0	1 to 6	2011	60	ABC	SEI	N	24.8	177.14
A05	Commerci	Other	North Ame	New	930 to 2323	10,001 to 25,000	0	1 to 6	2014	75	ABCD	SFEI	N	1129.47	623.88
A05	Commerci	Other	North Ame	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2012	60	ABC	SFE	N	1376.21	274.23
A05	Commerci	Office	North Ame	New	930 to 2323	10,001 to 25,000	0	1 to 6	2013	50	ABCD	SFEI	N	1062.8	259.57
A05	Commerci	Other	North Ame	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2012	60	ABC	SFE	N	1291.95	259.35
A05	Commerci	Mixed	North Ame	New	4646 to 9290	50,001 to 100,000	0	7 to 14	2015	50	ABC	SFEI	N	1074.81	154.34
A05	NonComm	Industrial	North Ame	New	930 to 2323	10,001 to 25,000	0	1 to 6	2014	60	ABCD	SFEI	N		
A05	Commerci	Other	North Ame	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2012	60	ABC	SFE	N		
A05	Commerci	Other	North Ame	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2012	73	ABC	SFE	N		
A05	Commerci	Other	North Ame	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2012	60	ABC	SFE	N		
A05	Commerci	Other	North Ame	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2012	73	ABC	SFE	N		
A05	Commerci	Other	North Ame	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2012	60	ABC	SFE	N		
A05	Commerci	Other	North Ame	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2012	73	ABC	SFE	N		
A05	Commerci	Other	North Ame	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2012	60	ABC	SFE	N		
A05	Commerci	Other	North Ame	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2012	73	ABC	SFE	N		
A05	Commerci	Other	North Ame	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2012	60	ABC	SFE	N		
A05	Commerci	Other	North Ame	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2012	73	ABC	SFE	N		
A05	Commerci	Other	North Ame	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2012	60	ABC	SFE	N		
A05	Commerci	Other	North Ame	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2012	73	ABC	SFE	N		
A05	Commerci	Other	North Ame	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2012	60	ABC	SFE	N		
A05	Commerci	Other	North Ame	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2012	73	ABC	SFE	N		
A05	Commerci	Other	North Ame	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2012	60	ABC	SFE	N		
A05	Commerci	Other	North Ame	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2012	73	ABC	SFE	N		
A05	Commerci	Other	North Ame	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2012	60	ABC	SFE	N		
A05	Commerci	Other	North Ame	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2012	73	ABC	SFE	N		
A05	Commerci	Other	North Ame	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2012	60	ABC	SFE	N		
A05	Commerci	Other	North Ame	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2012	73	ABC	SFE	N		
A05	Commerci	Public Ass	North Ame	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2012		A	SFE	Y	888	
A05	Commerci	Public Ass	North Ame	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2012		A	SFE	Y	763	
A05	Commerci	Public Ass	North Ame	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2012		A	SFE	Y	643	

A05	Commerci	Education	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2013	60	ABCD	Other	Y	2206	905
A05	Commerci	Office	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2012	100	ABC	SFEI	Y	2052.41	340.29
A05	Commerci	Office	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2012	100	ABC	SFEI	Y	2590.98	336.85
A05	Commerci	Office	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2013	100	ABC	SFEI	N	2041.32	248.9
A05	Commerci	Office	North Am	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2013	100	ABC	SFEI	Y	2191.06	
A05	Residentia	Single-fam	North Am	New	94 to 465	1,001 to 5,000	0		2014	60	ABCD	SFEI	Y	184.79	746.64
A05	Commerci	Lodging	North Am	New	9291 to 18580	100,001 to 200,000	0		2014		ABCD	SFEI	Y	10588.7	710.91
A05	Commerci	Education	North Am	New	2324 to 4645	25,001 to 50,000	0		2014		ABCD	SFEI	Y	2705.64	608.58
A05	Commerci	Lodging	North Am	New	9291 to 18580	100,001 to 200,000	0		2014		ABCD	SFEI	Y	6678.35	551.2
A05	Commerci	Public Ass	North Am	New	94 to 465	1,001 to 5,000	0		2014	60	ABCD	Other	Y	190.08	494.32
A05	Commerci	Lodging	North Am	Renovatio	9291 to 18580	100,001 to 200,000	0		2014		ABCD	SFEI	Y	9290.04	437.51
A05	Commerci	Public Ass	North Am	New	94 to 465	1,001 to 5,000	0		2014	60	ABCD	SFEI	Y	144.85	363.87
A05	Commerci	Lodging	North Am	New	9291 to 18580	100,001 to 200,000	0		2015	60	ABCD	SFE	Y	3468.13	240.03
A05	Residentia	Single-fam	North Am	New	466 to 929	5,001 to 10,000	0		2015		ABCD	SFEI	Y	125.64	150.9
A05	Residentia	Single-fam	North Am	New	466 to 929	5,001 to 10,000	0		2015		ABCD	SFEI	Y	100.49	113.96
A05					93 or less	1,000 or less	0				C	SFEI	Y	86.39	638.11
A05	Commerci	Education	North Am	New	18581 to 46451	200,001 to 500,000	0		2013	100	A	SFEI	Y	15895.79	574.12
A05	Commerci	Education	North Am	New	2324 to 4645	25,001 to 50,000	0		2013	60	A	SFEI	Y	1911.91	496.41
A05	Commerci	Public Ass	North Am	New	18581 to 46451	200,001 to 500,000	0				A	SFEI	Y	23005	495.51
A05	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0		2013	100	A	SFEI	Y	2366.49	450.67
A05	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0		2013	100	A	SFEI	Y	2627.88	435.44
A05	Commerci	Education	North Am	New	930 to 2323	10,001 to 25,000	0		2013	100	A	SFEI	Y	747.49	411.89
A05	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0		2013	100	A	SFEI	Y	2302.43	409.47
A05					93 or less	1,000 or less	0				C	SFEI	Y	40.1	396.07
A05					9291 to 18580	100,001 to 200,000	0				C	SFEI	Y	7878	349.55
A05	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0		2013	60	A	SFEI	Y	1612.74	342.52
A05	Commerci	Education	North Am	New	9291 to 18580	100,001 to 200,000	0		2013	100	A	SFEI	Y	3199.72	335.82
A05					4646 to 9290	50,001 to 100,000	0				C	SFEI	Y	3722.73	324.75
A05	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0		2013		A	SFEI	Y	2699.45	320.22
A05	Commerci	Public Ass	North Am	New	9291 to 18580	100,001 to 200,000	0				A	SFEI	Y	3553.48	312.53
A05	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0		2013	100	A	SFEI	Y	1769.06	306.23
A05	Commerci	Education	North Am	New	9291 to 18580	100,001 to 200,000	0		2013	60	A	SFEI	Y	4575.46	297.93
A05	Commerci	Lodging	North Am	New	9291 to 18580	100,001 to 200,000	0				C	SFEI	Y	6574.69	282.3
A05	Commerci	Public Ass	North Am	New	18581 to 46451	200,001 to 500,000	0				A	SFEI	Y	4881.84	261.91
A05	Commerci	Education	North Am	New	9291 to 18580	100,001 to 200,000	0		2013	100	A	SFEI	Y	2228.55	232.21
A05	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0		2013	100	A	SFEI	Y	1186.5	222.19
A05	Commerci	Education	North Am	New	9291 to 18580	100,001 to 200,000	0		2013	60	A	SFEI	Y	2205.25	213.43
A05	Commerci	Education	North Am	New	18581 to 46451	200,001 to 500,000	0		2013	60	A	SFEI	Y	3998.57	196.66
A05					18581 to 46451	200,001 to 500,000	0				C	SFEI	Y	4455	195.57
A05					94 to 465	1,001 to 5,000	0				C	SFEI	Y	96.13	137.69
A05	Commerci	Lodging	North Am	New	9291 to 18580	100,001 to 200,000	0				C	SFEI	Y	2031.71	131.32
A05	Commerci	Lodging	North Am	New	4646 to 9290	50,001 to 100,000	0				C	SFEI	Y	1276.26	117.03
A05					94 to 465	1,001 to 5,000	0				C	SFEI	Y	42.17	113.87
A05	Commerci	Education	North Am	New	18581 to 46451	200,001 to 500,000	0		2013	100	A	SFEI	Y	3218.1	109.11
A05	Commerci	Education	North Am	New	18581 to 46451	200,001 to 500,000	0		2013	60	A	SFEI	Y	2241.14	102.71
A05	Commerci	Education	North Am	New	2324 to 4645	25,001 to 50,000	0		2013		A	SFEI	Y	369.75	79.82
A05	Commerci	Education	North Am	New	2324 to 4645	25,001 to 50,000	0		2013	40	A	SFEI	Y	170.2	68.81

A05	Residentia	Single-fam	Europe	New	94 to 465	1,001 to 5,000	0	1 to 6	2012	50	AB			281.28	1465
A05	Residentia	Multi-fami	Asia-Pacifi	New	9291 to 18580	100,001 to 200,000	0	More than	2011	100	ABC			13515.29	926
A05	Residentia	Multi-fami	Asia-Pacifi	New	2324 to 4645	25,001 to 50,000	0	7 to 14	2012	50	AB	SEI	N	3407	864.06
A05	Commerci	Mixed	North Am	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2007		ABCD	SFEI	Y	12200	837.2
A05	Commerci	Other	Asia-Pacifi	New	18581 to 46451	200,001 to 500,000	0	7 to 14	2012	50	ABCD	SEI		108791.5	803.15
A05	Residentia	Multi-fami	Asia-Pacifi	New	4646 to 9290	50,001 to 100,000	0	More than	2011		ABC	SFEI		6549.15	737.31
A05	Residentia	Multi-fami	Asia-Pacifi	New	4646 to 9290	50,001 to 100,000	0	More than	2011		ABC	SFEI		6358.73	716.09
A05	Residentia	Multi-fami	Asia-Pacifi	New	4646 to 9290	50,001 to 100,000	0	More than	2011		ABC	SFEI		6266.08	703.43
A05	Residentia	Multi-fami	Asia-Pacifi	New	4646 to 9290	50,001 to 100,000	0	More than	2011		ABC	SFEI		6123.96	687.54
A05	Residentia	Multi-fami	Asia-Pacifi	New	9291 to 18580	100,001 to 200,000	0	More than	2011		ABC	SFEI		6635.83	667.98
A05	Residentia	Multi-fami	Asia-Pacifi	New	9291 to 18580	100,001 to 200,000	0	More than	2011		ABC	SFEI		6532.57	657.93
A05	Residentia	Multi-fami	Asia-Pacifi	New	9291 to 18580	100,001 to 200,000	0	More than	2011		ABC	SFEI		6395.2	641.22
A05	Residentia	Multi-fami	Asia-Pacifi	New	2324 to 4645	25,001 to 50,000	0	15 to 25	2011	60	ABC			11439.83	634.21
A05	Residentia	Multi-fami	Asia-Pacifi	New	2324 to 4645	25,001 to 50,000	0	7 to 14	2012	50	AB	SEI	N	2482	629.47
A05	Residentia	Multi-fami	Asia-Pacifi	New	9291 to 18580	100,001 to 200,000	0	More than	2011		ABC	SFEI		6253.34	626.96
A05	Residentia	Single-fam	Europe	New	93 or less	1,000 or less	0	1 to 6	2011		AC	SFEI		52	612
A05	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	7 to 14	2003	75	ABCD	SEI	Y	4657.5	591.78
A05	Residentia	Multi-fami	Asia-Pacifi	New	2324 to 4645	25,001 to 50,000	0	7 to 14	2012	50	AB	SEI	N	2280	578.24
A05	Commerci	Mercantile	North Am	New	466 to 929	5,001 to 10,000	0	1 to 6	2011	50	ABC	SFEI	Y	322	549.49
A05	Residentia	Single-fam	Europe	New	93 or less	1,000 or less	0	1 to 6	2011		AC	SFEI		45.6	535
A05	Commerci	Mercantile	North Am	New	466 to 929	5,001 to 10,000	0	1 to 6	2011	50	ABC	SFEI	Y	306	522.18
A05	Commerci	Mercantile	North Am	New	466 to 929	5,001 to 10,000	0	1 to 6	2011	50	ABC	SFEI	Y	303	517.06
A05	Residentia	Multi-fami	Asia-Pacifi	New	2324 to 4645	25,001 to 50,000	0	15 to 25	2011	60	ABC			13848.18	488.57
A05	Residentia	Multi-fami	Asia-Pacifi	New	9291 to 18580	100,001 to 200,000	0	More than	2011	100	ABC			7687.99	462
A05	Commerci	Mercantile	North Am	New	466 to 929	5,001 to 10,000	0	1 to 6	2011	50	ABC	SFEI	Y	264	450.51
A05	Residentia	Multi-fami	Asia-Pacifi	New	9291 to 18580	100,001 to 200,000	0	More than	2011	100	ABC			6461.95	443
A05	Residentia	Single-fam	Europe	New	93 or less	1,000 or less	0	1 to 6	2011		AC	SFEI		34.6	405
A05	Residentia	Single-fam	Europe	New	94 to 465	1,001 to 5,000	0	1 to 6	2012	50	AB			73.92	385
A05	Residentia	Single-fam	Europe	New	94 to 465	1,001 to 5,000	0	1 to 6	2012	50	ABCD	SFEI	Y	38.3	362.07
A05	Commerci	Mercantile	North Am	New	466 to 929	5,001 to 10,000	0	1 to 6	2011	50	ABC	SFEI	Y	208	354.95
A05	Residentia	Single-fam	Asia-Pacifi	New	93 or less	1,000 or less	0	1 to 6	2011					16957.2	326.1
A05	Residentia	Multi-fami	Europe	New	2324 to 4645	25,001 to 50,000	0	7 to 14	2010	100	ABC	SFEI	Y	-376	314
A05	Residentia	Multi-fami	Europe	New	2324 to 4645	25,001 to 50,000	0	7 to 14	2010	50	ABC	SFEI	Y	-376	314
A05	Residentia	Single-fam	Europe	New	93 or less	1,000 or less	0	1 to 6	2012	50	ABCD	SFEI	Y	19.86	273.15
A05	Residentia	Single-fam	Europe	New	94 to 465	1,001 to 5,000	0	1 to 6	2012	50	AB			38.4	200
A05	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2012	60	ABCD	SFE	N	42691.68	199.29
A05	Residentia	Single-fam	Europe	New	93 or less	1,000 or less	0	1 to 6	2012	50	ABCD	SFEI	Y	8.8	179.03
A05	Residentia	Single-fam	Europe	New	94 to 465	1,001 to 5,000	0	1 to 6	2012	50	AB			32.64	170
A05	Residentia	Single-fam	Asia-Pacifi	New	93 or less	1,000 or less	0	1 to 6	2011				Y	8782.8	168.9
A05	Residentia	Multi-fami	Europe	New	930 to 2323	10,001 to 25,000	0	1 to 6	2007		ABD	SFE	N	229.24	
A05	Residentia	Multi-fami	Europe	New	930 to 2323	10,001 to 25,000	0	1 to 6	2007		ABD	SFE	N	234.82	
A05	Residentia	Multi-fami	Europe	New	930 to 2323	10,001 to 25,000	0	1 to 6	2007		ABD	SFE	N	221.9	
A05	Residentia	Multi-fami	Europe	New	930 to 2323	10,001 to 25,000	0	1 to 6	2007		ABD	SFE	N	214.46	
A05	Residentia	Multi-fami	Europe	New	930 to 2323	10,001 to 25,000	0	1 to 6	2007		ABD	SFE	N	235.97	
A05	Residentia	Multi-fami	Europe	New	930 to 2323	10,001 to 25,000	0	1 to 6	2007		ABD	SFE	N	193.3	
A05	Residentia	Multi-fami	Europe	New	930 to 2323	10,001 to 25,000	0	1 to 6	2007		ABD	SFE	N	181.86	
A05	Residentia	Multi-fami	Europe	New	930 to 2323	10,001 to 25,000	0	1 to 6	2007		ABD	SFE	N	230.5	

A05	Residentia	Multi-fami	Europe	New	930 to 2323	10,001 to 25,000	0	1 to 6	2007		ABD	SFE	N	154.08
A05	Commerci	Mixed	Europe	New	46452 to 92903	500,001 to 1 million	0	1 to 6	2011	25	AB	SFE	Y	140000
A05	Residentia	Multi-fami	Asia-Pacifi	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2014		A	SFE	N	
A05	Residentia	Multi-fami	Asia-Pacifi	New	2324 to 4645	25,001 to 50,000	0	1 to 6	2014		A	SFE	N	
A05	Commerci	Education	North Am	Renovatio	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	60	ABCD	SFE	N	34333.92
A05	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	60	ABCD	SFE	N	3884.03
A05	Commerci	Education	North Am	Renovatio	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	60	ABCD	SFE	N	25633.8
A05	Commerci	Education	North Am	Renovatio	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	60	ABCD	SFE	N	17104.85
A05	Commerci	Education	North Am	Renovatio	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	60	ABCD	SFE	N	8575.91
A05	Commerci	Education	North Am	Renovatio	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	60	ABCD	SFE	N	2839.03
A05	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	60	ABCD	SFE	N	36145.1
A05	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	60	ABCD	SFE	N	27444.98
A05	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	60	ABCD	SFE	N	18156.09
A05	Commerci	Education	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2013	60	ABCD	SFE	N	12185.74
A05	Commerci	Office	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2015		ABC	SFE		3860
A05	Commerci	Office	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2015		ABCD	SFE		4070
A05	Commerci	Office	North Am	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2015	60	ABC	SFE		6328.57
A05	Commerci	Office	North Am	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2015	60	ABCD	SFE		6349.11
A05	Commerci	Office	North Am	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2015	60	ABC	SFE		7700
A05	Commerci	Office	North Am	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2015	60	ABCD	SFE		8150
A05	Commerci	Office	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2015	60	ABC	SFE		4010
A05	Commerci	Office	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2015	60	ABCD	SFE		4040
A05	Commerci	Office	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2015	60	ABC	SFE		2787
A05	Commerci	Office	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2015	60	ABCD	SFE		2982.15
A05	Commerci	Office	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2015		ABC	SFE		10700
A05	Commerci	Office	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2015		ABCD	SFE		11600
A05	Commerci	Office	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2015	60	ABC	SFE		2520
A05	Commerci	Office	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2015	60	ABCD	SFE		2790
A05	Commerci	Office	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2015	60	ABCD	SFE		10700
A05	Commerci	Office	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2015	60	ABC	SFE		10000
A05	Commerci	Office	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2015	60	ABC	SFE		8660
A05	Commerci	Office	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2015	60	ABCD	SFE		8760
A05	Commerci	Office	North Am	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2015	60	ABC	SFE		3302.17
A05	Commerci	Office	North Am	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2015	60	ABCD	SFE		3052.07
A05	Commerci	Office	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2015		ABC	SFE		5330
A05	Commerci	Office	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2015		ABCD	SFE		4750
A05	Commerci	Office	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2015		ABC	SFE		3540
A05	Commerci	Office	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2015		ABCD	SFE		3750
A05	Commerci	Office	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2015	60	ABC	SFE		6040
A05	Commerci	Office	North Am	New	18581 to 46451	200,001 to 500,000	0	1 to 6	2015	60	ABCD	SFE		4270
A05	Commerci	Office	North Am	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2015	60	ABC	SFE		3032
A05	Commerci	Office	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2015	60	ABC	SFE		2728
A05	Commerci	Office	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2015	60	ABC	SFE		1530
A05	Commerci	Office	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2015	60	ABCD	SFE		904
A05	Commerci	Office	North Am	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2015	60	ABC	SFE		4800
A05	Commerci	Office	North Am	New	9291 to 18580	100,001 to 200,000	0	7 to 14	2015	60	ABCD	SFE		2990
A05	Commerci	Office	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2015	60	ABC	SFE		2520

A05	Commerci	Office	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2015	60	ABCD	SFE		1810	
A05	Commerci	Office	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2015	60	ABC	SFE		2256.15	
A05	Commerci	Office	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2015	60	ABCD	SFE		1303.1	
A05	Commerci	Office	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2015	60	ABC	SFE		7710	
A05	Commerci	Office	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2015	60	ABCD	SFE		8070	
A05	Residentia	Single-fam	North Am	New	94 to 465	1,001 to 5,000	0	1 to 6	1998	50	ABC	SFEI	Y		185.89
A05	Residentia	Single-fam	North Am	New	94 to 465	1,001 to 5,000	0	1 to 6	1998	50	ABC	SFEI	Y		181.18
A05	Commerci	Office	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2012		A	S	N	5980	
A05	Commerci	Office	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2012		A	S	N	2370	
A05	Commerci	Office	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2012	50	A	SFE	N	5977.86	
A05	Commerci	Office	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2012	50	A	SFE	N	1793.36	
A05	Commerci	Warehous	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2014	60	ABC	SFE	N	3296.81	
A05	Commerci	Warehous	North Am	New	9291 to 18580	100,001 to 200,000	0	1 to 6	2014	60	ABC	SFE	N	2774.43	
A05	Commerci	Mixed	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2002	75	ABC	SFE	N	5083.8	
A05	Commerci	Mixed	North Am	New	4646 to 9290	50,001 to 100,000	0	1 to 6	2002	75	ABC	SFE	N	4590	
A05	Residentia	Single-fam	North Am	New	94 to 465	1,001 to 5,000	0	1 to 6	2001	50	ABC	SFEI	Y	370	
A05	Residentia	Single-fam	North Am	New	94 to 465	1,001 to 5,000	0	1 to 6	2001	50	ABC	SFEI	Y	1010	

University of Washington
College of Built Environments
Department of Architecture

CARBON LEADERSHIP FORUM

Embodied Carbon Benchmark Study

LCA for Low Carbon Construction Project

APPENDIX B: METHDOLOGY

1 METHODOLOGY

1.1 Background

Benchmarking methodologies have a wide-ranging history outside of the building industry. The word 'benchmark' was first used exclusively in topography to precisely define a reference point in terrain or geological analysis (Nikolaou, et al. 2015). The business sector has used benchmarking techniques extensively to reveal gaps between the benchmarker's performance and the benchmarked 'best practice' leader (Stauffer 2003).

In urban settings, city benchmarking entails the comparison of urban indicators between cities to understand how city is performing compared to past performance, best performance, or best practice. Per a recent review by Kitchin et al., the process is often accompanied with score-carding (Kaplan & Norton, 1992), whereby tables of rankings and ratings, along with changes in relative position, are produced to reveal which places are doing well and who has caught up with or fallen behind leading places (Gruppa & Mogee 2004). Benchmarking sets an aspirational and competitive agenda in terms of relative performance to others and thus can be used to motivate policy changes deemed necessary to alter their current practices (Kitchin, Laurilaut and McArdle 2015).

Benchmarking studies have been used in the building industry for the last 30 years primarily to compare the energy performance of a proposed building with other buildings. Per Nikolaou et al, in the 1990s, the term 'building energy benchmarking' started to be used to refer to the comparison of energy use in buildings of similar characteristics. Torcellini et al reviewed several benchmarking efforts developed to understand prototypical energy usage. These included the set of standardized energy simulation models for commercial buildings from the University of Massachusetts and the residential building benchmark from the Department of Energy (DOE) Building America Program, which was created to provide a common baseline for determining energy savings for a proposed or existing residential buildings using hourly energy simulations (Torcellini, et al. 2008). Other recent energy benchmarking efforts include the Commercial Building Energy Consumption Survey (CBECS), which is the only comprehensive commercial building survey in the U.S. (EIA 2012).

The building industry has developed only few efforts to benchmark embodied carbon in buildings. Some of these include the Athena Report for Incorporating Whole Building LCA Benchmarks into the IE4B, the European SuPerBuildings Project, the Australian Materials and Buildings Products Life Cycle Inventory Database, and the French "Construisons Ensemble HQE Performance."

The data in this study is limited to the embodied carbon databases available to the research team and to the LCA studies that could be read and compiled within the time limitations of the research project (summer and fall of 2016). The data is from non-aligned

LCA studies that used different building scopes, different LCA data, and different LCA methods.

1.2 Parameters

In developing the database parameters, the research team began by assessing the parameters used in the available embodied carbon datasets. The final selected parameters were those that had the highest degree of overlap between the source databases and thus could result in the most complete database possible given the input sources.

Of note, these are not the ideal database parameters that would be recommended for an original database generated from new LCA data. Tables 1 & 2 list the parameters used in the final database, and Table 3 lists additional recommended parameters. Additionally, the data presented in the research database is simplified into general categories (such as ranges rather than specific floor areas) to ensure that individual data points cannot be linked to a specific building, providing additional confidentiality. The database parameters have been categorized as 'building' parameters (those that relate to descriptions of the building) and 'LCA' parameters (those that relate to the goal, scope, and methods of the LCA).

This study will categorize buildings using typical building categories in well-established building energy benchmarks -- Commercial Building Energy Consumption Survey (CBECS) – as well as categories similar to those outlined in the Athena Whole Building LCA Benchmark Framework Investigation (Bowick, 2014) using the United Nations' *Central Product Classification* (UN CPC) to identify five building 'types' differentiated by building height.

Alignment with the CBECS energy consumption database has the advantage of enabling integration of embodied and operational energy consumption. However, additional refinement of building scale may be more relevant for embodied carbon data as taller buildings trigger specific building code requirements related to fire rating and high rise construction that may impact the material requirements and not impact energy consumption.

Commercial buildings are defined per the CBECS as "Any building that is neither residential, manufacturing/industrial (used for processing or procurement of goods, merchandise raw materials or food), nor agricultural. At least 50 percent of the floor space must be used for purposes other than these for a building to be considered "commercial" (EIA 2012). For commercial buildings, the classification includes the following principal activities: education, food sales, food service, health care, lodging, mercantile, office, public assembly, public order and safety, religious worship, service, warehouse and storage (DOE 2015) (EIA 2012).

The energy performance indicators most widely used for whole building energy consumption is the Energy Performance Indicator (EPI) or the Energy Use Intensity (EUI)

(Nikolaou, Kolokotsa, Stavrakakis, Apostolou, & Munteanu, 2015). Typically, EPI or EUI is used for many buildings and can be obtained by normalizing annual energy use with floor area and/or operational hours. These types of studies will typically use annual energy consumption and floor area to calculate EUI, i.e., MJ/ft^2 or kWh/m^2 (Torcellini, Deru, Griffith, & Benne, 2008) (Mathew, Dunn, Sohn, Mercado, Custudio, & Walter, 2015) but in past studies energy per worker or energy per bed has also been used (Nikolaou, Kolokotsa, Stavrakakis, Apostolou, & Munteanu, 2015).

This study normalizes embodied carbon in the buildings per floor area with units of kg$CO2_e$/m^2

Table 1: Research Database Building Characteristics Parameters

Parameter	Name	Variables/Units	Notes
BLDG_PUBID	Public ID	Numeric Code	To enable sorting. Source not publicly identified.
BLDG_TYP	Building Type	Commercial / Residential	
BLDG_US	Use	Per CBECS	Aligned with Commercial Building Energy Consumption Survey
BLDG_YEAR	Year	Year range	Year of construction.
BLDG_LOC_REGION	Location	Region	City and Country removed for public data
BLDG_NEW_REN	Construction	New / Renovation	
$BLDG_AREA_M2	Internal Area	Square meter	Area stepped to align with CBECS and for confidentiality
$BLDG_STOR_A	Stories	Stories above grade	No detail over 25 stories for confidentiality

Table 2: LCA Parameters

Parameter	Name	Variables/Units	Notes
LCA_YEAR	Date	Year	When the study was performed
LCA_REFPERIOD	Time	Years	Reference study period/building life
LCA_SOUR_CODE	LCI	Dataset	Grouped but not identified for confidentiality
LCA_STAGES	LCA Stages	A, B, C, D	A = Cradle through construction, B = Use, C = End of Life D= Outside System Boundary
LCA_BLDG_SCOPE	Scope	S, F, E, I	S = Structure, F = Foundation, E = Enclosure, I = Interior
LCA_MAT_Q	Material	Yes or No	Did study report material quantities?
EC_LCAA_PERM2	Result	CO2e/m2	LCA Stage A (A1-A3 or A1-A5)
EC_WB_EX_OPER	Result	tCO2e	Total tons (1000 kg) of CO2e from all studied LCA stages

Of note, while the primary structural material type was collected in the confidential database, this information is not included in the research database. Additional parameters that would have been valuable to collect, but were not available for most of our data points, are listed in Table 3.

Table 3: Additional Desired Building and LCA Parameters

Parameter	Name	Variables/Units	Notes
BLDG_HAZ_SEIS	Seismic Hazard	Seismic Zone	
BLDG_HAZ_WIND	Wind Hazard	High Wind	
BLDG_CLIM_ZN	Climate Zone	Per CBECS	
LCA_MAT_Q	Material Quantities		Would like a report of the quantities of materials
Biogenic	Biogenic Carbon	Y/N	Not always clear if biogenic carbon included
Results	Embodied Carbon	$CO2_e/m^2$	Detailed breakdown per LCA stage

Energy	Energy	GJ/m^2	Report Embodied Energy as well

1.3 Database Development

The database was developed, consolidated, and analyzed in five stages as outlined in Figure 1 below.

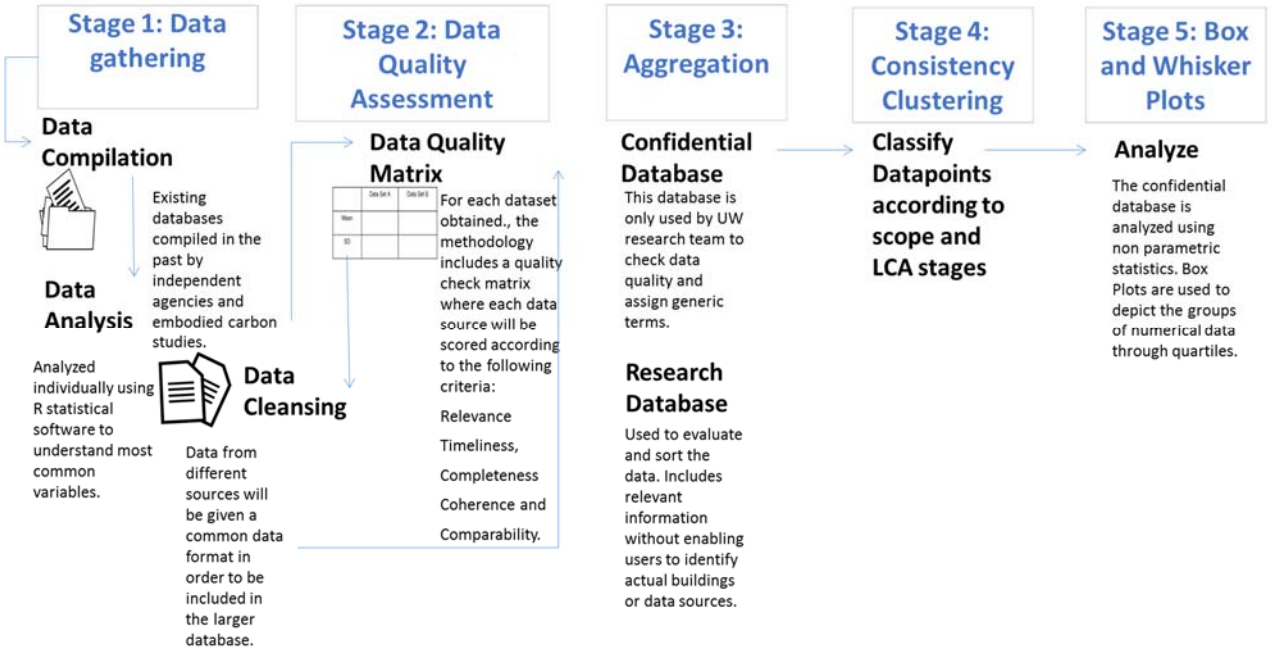


Figure 1: Stages of Database Development and Benchmark Analysis

1.3.1 Stage 1: Data gathering and cleansing

An important objective of this study is to bring together the disparate sources of data and develop a data format that facilitates aggregation and analysis. Per a recent study, widespread data collection is a relatively recent phenomenon in the buildings sector, which means there are no widely used standards for formatting data or quality control (Mathew, et al. 2015). Thus, this project has elaborated a format and established guidelines for fields and most common variables analyzed (parameters).

The datasets of existing embodied carbon were collected from two types of sources: 1) existing databases compiled in the past by independent agencies, and 2) a UW database that compiled the results of disparate embodied carbon studies. These datasets were analyzed individually using statistical software R (R Core Team, 2013) to understand variance and distribution, and the results are also graphically displayed and evaluated. After the first analysis, the data from different sources was given a common data format to be included in the larger database and aligned/'cleansed'. The primary

focus of this effortwasto align database parameters and format (not to check) the results of the original analysis.

1.3.2 Stage 2: Data Quality Assessment

A data quality assessment was performed for each dataset obtained. The methodology includes a quality check matrix where each data source was assessed for *relevance, timeliness, completeness, coherence, and comparability*. The assessment compared key variables (i.e. embodied carbon LCA stage A) against distribution of similar buildings in the database to identify outliers. The data quality reports were then distributed to the organizations that donated databases. Through this process, the organizations identified suspect data points to be removed from the database. The UW research team identified entries that were of both low quality/confidence and outside the statistical range (the top two data points that were off by a factor of 30 from the mean).

1.3.3 Stage 3 Data Aggregation and Privacy

Over 1,000 entries were assembled into a compiled database that was termed the 'CONFIDENTIAL' database, which encompassed all raw data and was only used by the UW team to evaluate the overall database. The 'CONFIDENTIAL' database was transformed into the 'RESEARCH' database in order to ensure project privacy prior to public dissemination. One of the most common strategies used to provide confidentiality is show users only aggregated data (Howard and Sharp 2010) and suppress results for 'type groups' fewer than a certain amount of buildings (Mathew, et al. 2015) to reduce the possibility that users will be able to single out embodied carbon data for any particular building. For this project, sensitive information such as the exact floor area, building city, and number of floors for tall towers were transformed to ensure that individual projects couldn't be identified based on the parameters published in the 'RESEARCH' database.

Stage 4 Consistency Clustering: To ensure the consistency of the dataset, the database was classified into 5 clusters based on the two most populated building scopes: SF (superstructure and foundations) and SFEI (superstructure, foundations, enclosure, and interiors) for life cycle stage A. This clustering enabled the statistical analysis of subsets of the data that are more aligned in LCA scope than is seen in the combined database. For more detail see Appendix B: Statistical Analysis.

Stage 5 Box and Whisker Plot Analysis: Each individual cluster was analyzed using non-parametric statistics. The box and whisker plot analysis depicts variability outside of the upper and lower quartiles. These plots are presented in Section 3.

University of Washington
College of Built Environments
Department of Architecture

CARBON LEADERSHIP FORUM

Embodied Carbon Benchmark Study

LCA for Low Carbon Construction Project

APPENDIX C: Statistical Analysis

STATISTICAL ANALYSIS TO INFORM EMBODIED CARBON BENCHMARKS

Independent Study SEFS 600A

Professor: Indroneil Ganguly

Based on previous study “Embodied Carbon Benchmark Study: LCA for Low Carbon Construction Project”

PI: Kathrina Simonen

Student: Barbara Rodriguez Droguett Program: Built Environment Program

December 30, 2016

Contents

I SCOPE AND OBJECTIVES

This Exploratory Data Analysis (EDA) uses several statistical tools to inform embodied carbon benchmarks developed under the project called "Life Cycle Assessment (LCA) for Low Carbon Construction Stage 1: Embodied Carbon Benchmarks". The main objective of this project is to – "establish reasonable benchmarks of the embodied carbon of buildings and characterize the level and sources of uncertainty in our knowledge of embodied carbon from building construction" Practitioners assessing the embodied carbon of different projects, using LCA, do not have a clear 'benchmark', or point of reference against which their designs may be compared or assessed. Under this previous study the Embodied Carbon Database (ECD) was developed using 23 different data sources, in the second stage of this study we analyzed the data using box and whisker plots.

This study is intended to provide a statistical analysis to the ongoing study using the previous ECD database, the scope of this study is described as follow:

Step 1: Database Development (Previous Study)
Step 2: Data Quality Assessment (Previous Study)
Step 3: Aggregation (Box and Whisker plots) (Previous Study)

Step 4: Consistency Clustering- Descriptive Statistics
Step 5: Statistical Analysis of the Data
    Step 5a: Correlation Analysis
    Step 5b: ANOVA Analysis

II METHODOLOGY

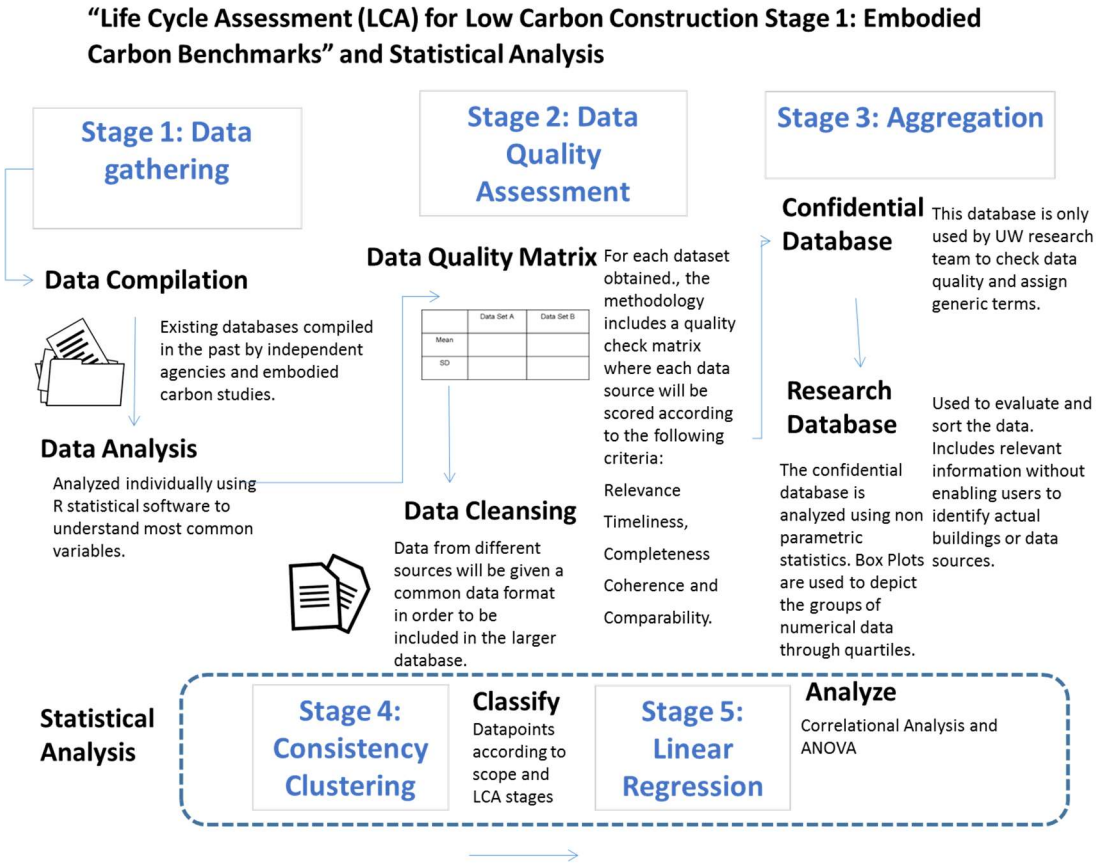


Figure 2. Research Objectives, stages and expected results

III DATABASE DESCRIPTION: Embodied Carbon Database (ECD)

The database contains 1191 observations for 36 variables. From the 36 variables, 21 are building characteristics, 11 are characteristics of the LCA study and 4 are embodied carbon indicators. In the ECD, there are 4 scalar variables, and 4 indicators.

III.A Variables

Table 1: Variables by Type

BUILDING CHARACTERISTICS	BLDG_PUBID	Public ID	nominal
	BLDG_NAM	Building Name	nominal
	BLDG_TYP	Building Type*	nominal
	BLDG_US	Building Use	nominal
	BLDG_LOC_REGION	Location Region	nominal
	BLDG_LOC_COU	Location_Country	nominal
	BLDG_LOC_CITY	Location_City	nominal
	BLDG_NEW_REN	New or Renovation*	categorical
	BLDG_YEAR	Year of Construction Completion	nominal
	$BLDG_YEAR	Category Year of Construction	interval
	BLDG_STRUC	Primary Structure*	categorical
	BLDG_AREA_M2	Internal Floor Area (m^2)	scalar
	$BLDG_AREA_M2	Categories of Building Area	interval
	BLDG_AREA_FT2	Internal Floor Area (sqft)	scalar
	$BLDG_AREA_FT2	Categories of Building Area	interval
	BLDG_HAZ_SEIS	Natural Hazard Zone:Seismic	categorical
	BLDG_HAZ_WIND	Natural Hazard Zone:Wind	categorical
	BLDG_CLIM_ZN	Climate Zone*	nominal
	BLDG_STOR_A	N of Stories:Above	scalar
	$BLDG_STOR_A	Categories N of Stories A	interval
	BLDG_STOR_B	N of Stories: Below	scalar
	LCA_YEAR	Year of LCA Study	nominal
	LCA_REFPERIOD	Referenced Study Period	nominal
	LCA_SOUR_ENVIMPACT	Source of Env Impact Fact	nominal
	LCA_SOUR_CODE	LCA Source of Env Impact Code	nominal
	LCA_YEAR_SOUR_EF	Year of Source of Env Impact Factors	nominal
	LCA_DGN_STAGE	Design Stage	categorical
	LCA_STAGES	LCA Stages	nominal
	LCA_BLDG_SCOPE	Building Scope*	categorical
	LCA_CSEQ	Carbon Sequestration	categorical
	LCA_REUSE	Reuse	categorical
	LCA_MAT_Q	Mat Quantities Reported	categorical
INDICATORS	EC_WB_EX_OPER	Whole Building Embodied CO2 (tCO2) - excludes operational	scalar
	EC_LCA_A	Cradle to Construction ECO2 (kgECO2/m2)	scalar
	EC_LCA_BCD	Other_Life-Cycle_Stages_ECO2(kgECO2/m2)	scalar
	EC_WB_PER_M	Whole Bldg ECO2(kg ECO2/m2)	scalar

III.B Cross Tabs ECD Complete (1191 Observations) for Building Characteristics

Table 02: Number of Buildings according to BLDG_USE and BLDG_TYPE

	COMMERCIAL	GENERIC	INDUSTRIAL	NON COMMERCIAL	RESIDENTIAL
BLANK	0	0	0	0	3
EDUCATION	183	0	0	0	0
HEALTH CARE	56	0	0	0	0
INDUSTRIAL	0	0	1	1	0
LODGING	22	0	0	0	0
MERCANTILE	13	0	0	0	0
MIXED	60	0	0	0	0
MULTI-FAMILY	1	0	0	0	76
OFFICE	362	0	0	0	0
OTHER	144	1	0	1	136
PARK	0	0	0	1	0
PARKING	3	0	0	4	0
PUBLIC ASSEMBLY	69	0	0	2	0
PUBLIC ORDER AND SAFETY	4	0	0	2	0
SINGLE-FAMILY	0	0	0	0	26
WAREHOUSE	7	0	0	0	0
TOTAL	**924**	**1**	**1**	**11**	241

Table 03: Number of Buildings according to BLDG_USE and BLDG_LOC_REGION

	AFRICA	ASIA PACIFIC	EUROPE	MIDDLE EAST	NORTH AMERICA	SOUTH AMERICA
BLANK	0	0	4	0	0	0
EDUCATION	0	3	13	1	142	0
HEALTH CARE	2	0	1	0	35	0
INDUSTRIAL	0	0	1	0	1	0
LODGING	0	5	1	1	15	0
MERCANTILE	0	0	4	0	5	0
MIXED	0	4	28	8	15	0
MULTI-FAMILY	0	41	13	0	21	0
OFFICE	0	63	98	5	150	1
OTHER	1	39	29	6	173	0
PARK	0	0	0	0	1	0
PARKING	0	1	0	2	4	0
PUBLIC ASSEMBLY	2	0	6	5	58	0
PUBLIC ORDER AND SAFETY	0	0	4	0	2	0
SINGLE-FAMILY	0	3	10	0	13	0
WAREHOUSE	0	0	0	0	2	0
TOTAL	5	**159**	**212**	**28**	637	1

Table 04: Number of Buildings according to BLDG_USE and BLDG NEWorRENOVATION

	NEW	RENOVATION
BLANK	16	0
EDUCATION	177	6
HEALTH CARE	56	0
INDUSTRIAL	2	0
LODGING	21	1
MERCANTILE	13	0
MIXED	59	1
MULTI-FAMILY	75	2
OFFICE	355	7
OTHER	274	8
PARK	1	0
PARKING	7	0
PUBLIC ASSEMBLY	71	0
PUBLIC ORDER AND S AFETY	6	0
SINGLE-FAMILY	25	1
WAREHOUSE	7	0
TOTAL	**1165**	**26**

TABLE 05: Number of Buildings according to BLDG_USE and BLDG YEAR

	1920 TO 1945	1946 TO 1959	1960 TO 1969	1970 TO 1979	1980 TO 1989	1990 TO 1999	2000 TO 2003	2004 TO 2007	2008 TO 2012	2013 TO 2015	2016 TO 2018	HYPOTHETICAL
BLANK	0	0	0	0	0	0	0	0	1	0	1	0
EDUCATION	3	4	14	1	2	1	2	5	17	1	0	0
HEALTH CARE	0	0	0	0	0	0	0	0	1	0	0	0
INDUSTRIAL	0	0	0	0	0	0	0	0	1	0	0	0
LODGING	0	0	0	0	1	2	0	1	2	6	0	0
MERCANTILE	0	0	0	0	0	0	0	0	0	0	0	0
MIXED	0	0	0	0	0	2	2	3	5	4	0	0
MULTI-FAMILY	0	0	0	0	0	2	11	10	2	11	0	0
OFFICE	0	1	0	2	13	23	14	19	24	23	1	20
OTHER	0	0	0	0	0	3	11	5	4	19	6	52
PARK	0	0	0	0	0	0	0	0	0	0	0	0
PARKING	0	0	0	0	0	0	1	0	4	0	0	0
PUBLIC ASSEMBLY	0	0	0	0	0	0	0	0	7	1	0	0
PUBLIC ORDER AND SA FETY	0	0	0	0	0	0	0	2	0	0	0	0
SINGLE-FAMILY	0	0	0	0	0	0	0	0	3	0	2	0
WAREHOUSE	0	0	0	0	0	0	0	2	0	0	0	0
TOTAL	**3**	**5**	**14**	**3**	**16**	**33**	**41**	**47**	**71**	**65**	**10**	**72**

TABLE 06: Number of Buildings according to BLDG_USE and BLDG STRUCTURAL TYPE

	CONCRETE	MASONRY	MIXED	STEEL	UNIQUE	WOOD
BLANK	3	0	0	2	0	3
EDUCATION	44	0	51	47	0	2
HEALTH CARE	16	0	14	25	0	0
INDUSTRIAL	0	0	1	1	0	0
LODGING	8	0	6	4	0	0
MERCANTILE	4	0	0	3	0	2
MIXED	15	1	7	5	0	1
MULTI-FAMILY	60	0	2	3	5	5
OFFICE	113	0	56	118	0	23
OTHER	106	21	23	52	0	20
PARK	0	0	0	0	0	0
PARKING	7	0	0	0	0	0
PUBLIC ASSEMBLY	9	0	22	28	0	5
PUBLIC ORDER AND SAFETY	0	0	2	0	0	0
SINGLE-FAMILY	1	7	4	3	0	11
WAREHOUSE	1	0	1	5	0	0
TOTAL	**387**	**29**	**189**	**296**	**5**	**72**

TABLE 07: Number of Buildings according to BLDG_USE and BLDG AREA (sq. ft.)

	1000 OR LESS	100001 TO 200000	10001 TO 25000	1001 TO 5000	200001 TO 500000	25001 TO 50000	500001 TO 1 MILLION	50001 TO 100000	5001 TO 10000	OVER 1 MILLION
BLANK	5	1	0	4	3	0	1	1	0	0
EDUCATION	0	46	27	5	18	25	3	49	10	0
HEALTH CARE	0	24	4	0	8	3	6	6	1	4
INDUSTRIAL	0	0	1	0	0	1	0	0	0	0
LODGING	0	6	2	0	4	0	7	2	0	1
MERCANTILE	0	4	0	4	0	0	0	0	5	0
MIXED	0	6	3	0	31	0	8	4	2	6
MULTI-FAMILY	0	12	9	0	17	18	10	9	0	2
OFFICE	32	66	11	0	44	34	48	37	1	89
OTHER	21	21	5	60	39	37	27	40	10	22
PARK	0	0	0	1	0	0	0	0	0	0
PARKING	0	0	2	0	3	0	0	0	0	2
PUBLIC ASSEMBLY	0	13	9	4	19	7	9	7	2	1
PUBLIC ORDER AND SAFETY	0	0	0	2	0	0	4	0	0	0
SINGLE-FAMILY	7	0	0	16	0	0	0	0	2	0
WAREHOUSE	0	2	0	0	3	0	2	0	0	0
TOTAL	**65**	**201**	**73**	**96**	**189**	**125**	**125**	**155**	**33**	**127**

TABLE 08: Number of Buildings according to BLDG_USE and BLDG NUMBER of STORIES ABOVE GROUND

	1 TO 6	15 TO 25	7 TO 14	MORE THAN 25
BLANK	6	0	0	0
EDUCATION	133	0	19	2
HEALTH CARE	39	3	11	3
INDUSTRIAL	2	0	0	0
LODGING	2	3	4	6
MERCANTILE	8	0	3	2
MIXED	15	2	30	13
MULTI-FAMILY	17	10	19	25
OFFICE	79	22	153	108
OTHER	180	10	61	24
PARK	0	0	0	0
PARKING	5	0	2	0
PUBLIC ASSEMBLY	46	1	14	4
PUBLIC ORDER AND SAFETY	3	0	3	0
SINGLE-FAMILY	22	0	0	0
WAREHOUSE	7	0	0	0
TOTAL	564	51	319	187

TABLE 09: Number of Buildings according to BLDG_USE and BLDG NUMBER of STORIES BELOW GROUND

	0	1	2	3	4	5	6	8	9	10
BLANK	0	2	0	0	1	0	0	0	0	0
EDUCATION	31	19	8	0	6	0	0	0	0	0
HEALTH CARE	18	0	2	0	0	0	0	0	0	0
INDUSTRIAL	0	0	1	0	0	0	0	0	0	0
LODGING	5	2	3	1	1	0	1	0	0	0
MERCANTILE	1	1	2	0	0	0	0	0	0	0
MIXED	4	18	9	1	1	1	0	0	0	0
MULTI-FAMILY	14	3	3	11	2	0	0	0	0	0
OFFICE	110	59	35	22	7	5	1	2	1	1
OTHER	61	51	17	2	1	1	0	0	0	0
PARK	0	0	0	0	0	0	0	0	0	0
PARKING	4	3	0	0	0	0	0	0	0	0
PUBLIC ASSEMBLY	5	1	4	0	0	0	0	0	0	0
PUBLIC ORDER AND SAFETY	0	1	2	0	1	0	0	0	0	0
SINGLE-FAMILY	3	4	0	0	0	0	0	0	0	0
WAREHOUSE	5	0	0	0	0	0	0	0	0	0
TOTAL	261	164	86	37	20	7	2	2	1	1

TABLE 10: Number of Buildings according to LCA Code and BLDG TYPE

	COMMERCIAL	GENERIC	INDUSTRIAL	NON COMMERCIAL	RESIDENTIAL
BLANK	80	0	1	4	12
05, 06, 07	3	0	0	0	0
05,08,09	11	0	0	0	0
05, 11	5	0	0	0	0
05, 12	2	0	0	0	0
05, 32	2	0	0	0	0
08, 05, 06	2	0	0	0	0
08, 05, 15	2	0	0	0	0
08, 16	0	0	0	0	2
1	10	0	0	0	0
10	1	0	0	0	12
10, 36	1	0	0	0	0
12	0	0	0	0	4
12, 05	1	0	0	0	0
12, 14	60	0	0	0	0
12, 27	2	0	0	0	0
13	0	0	0	0	2
14	322	1	0	4	42
14, 22, 07, 36, 40	1	0	0	0	0
17	0	0	0	0	18
17, 14, 18	8	0	0	0	4
17, 19	3	0	0	0	2
18	15	0	0	0	4
2	0	0	0	0	2
20	131	0	0	0	28
21, 17, 19	0	0	0	0	8
21, 22	2	0	0	0	0
23	15	0	0	0	0
24, 08, 39	0	0	0	0	2
24, 10, 12	1	0	0	0	0
25, 26	1	0	0	0	0
27	1	0	0	0	3
28	0	0	0	0	2
29	1	0	0	0	0
3	1	0	0	0	0
30	0	0	0	0	9
31	2	0	0	0	0
33	0	0	0	0	2
34	1	0	0	0	1
35	0	0	0	0	2
37	0	0	0	0	8
38	4	0	0	0	0
4	4	0	0	0	0
41	154	0	0	0	33
5	68	0	0	3	34
7	7	0	0	0	5
TOTAL	924	1	1	11	241

TABLE 11: LCA Environmental Impact Source Code

LEGEND	ORIGINAL SOURCE
01	1985 Input/Output (I/O) Table of Japan
02	1998 Japan energy mix. Hybrid ecoNmic input-output mode l
03	2002 EIO-LCA
04	Alcorn
05	Athena
06	US LCI
07	Ecoinvent
08	BEES
09	NIST
10	SimaPro
11	eQuest
12	Industry (association, private firms, publication)
13	AusLCI
14	BATH ICE
15	Envest
16	CRTI
17	BRE
18	Individual data
19	Eaton & Amato
20	GaBi
21	Concrete Centre
22	Corus
23	David Langdon
24	DEAM
25	EIO LCA
26	US EIA
27	Literature (including higher education)
28	Equer
29	eTool
30	GEMIS Software
31	Greg Hardie Spreadsheet
32	US EPA
33	Multiple
34	PECC Rev H
35	PV-BILD
36	Defra
37	SUSB-LCA
38	Tally
39	LCAD
40	Env product declarations

TABLE 12: Number of Buildings according to BLDG_TYPE and BLDG YEARS

	1990–2006	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
BLANK	0	0	0	0	0	2	1	0	0	0	2	0
COMMERCIAL	33	2	6	26	75	39	76	44	159	139	142	154
GENERIC	0	0	0	0	0	0	0	0	0	1	0	0
INDUSTRIAL	0	0	0	0	0	1	0	0	0	0	0	0
NONCOMMERCIAL	2	0	0	0	6	1	0	0	0	1	0	0
RESIDENTIAL	11	0	9	4	18	9	78	16	18	10	13	33
TOTAL	46	2	15	30	99	52	155	60	177	151	157	187

Table 13: Number of Buildings according to LCA_BLDG_SCOPE and LCA_STAGE

	A	ABC	ABCD	ABD	AC	B	BCD	BD	C	CD	D
BLANK	25	5	0	0	0	0	0	0	0	0	0
OTHER	4	0	2	0	0	0	0	1	0	17	0
S	66	0	0	0	0	1	0	3	0	0	0
SF	619	32	66	0	0	0	0	0	0	4	0
SFE	8	47	30	9	0	0	0	0	0	19	0
SFEI	88	37	36	0	3	21	5	9	20	0	1
TOTAL	**810**	**121**	**134**	**9**	**3**	**22**	**5**	**13**	**20**	**40**	**1**

Table 14: Number of Buildings according to LCA_BLDG_SCOPE and LCA REFERENCE YEARS

	20	25	30	35	40	50	60	70	73	75	100	120
BLANK	0	0	0	0	1	3	0	3	0	0	0	1
EDUCATION	0	0	0	0	7	87	24	0	0	3	10	0
HEALTH CARE	0	0	0	0	0	36	1	0	0	0	0	0
INDUSTRIAL	0	0	0	0	0	0	2	0	0	0	0	0
LODGING	0	0	0	0	9	6	1	0	0	0	0	0
MERCANTILE	0	0	0	0	0	9	0	0	0	0	0	0
MIXED	0	1	0	0	10	15	4	0	0	4	0	0
MULTI-FAMILY	0	0	0	0	33	5	6	0	0	3	10	0
OFFICE	1	0	3	0	97	17	85	0	0	3	68	0
OTHER	0	0	0	2	44	105	86	0	10	1	4	0
PARK	0	0	0	0	0	0	0	0	0	0	0	0
PARKING	0	0	0	0	3	0	0	0	0	0	0	0
PUBLIC ASSEMBLY	1	0	0	0	1	52	2	0	0	0	1	0
PUBLIC ORDER AND SAFETY	0	0	0	0	0	0	0	0	0	0	0	0
SINGLE-FAMILY	0	0	0	0	0	12	1	0	0	2	0	0
WAREHOUSE	0	1	1	0	0	0	2	0	0	0	0	0
TOTAL	**2**	**2**	**4**	**2**	**205**	**347**	**214**	**3**	**10**	**16**	**93**	**1**

III.C Descriptive Statistics ECD (1191 Observations)

Table 15: Descriptive Statistics Embodied Carbon Dataset

Statistic	N	Mean	St. Dev.	Min	Max
BLDG_AREA_M2	1,189	41,510.80	82,598.72	1.00	550,400.00
BLDG_AREA_FT2	1,189	446,725.10	888,730.60	10.76	5,924,451.00
BLDG_STOR_A	1,106	13.71	24.13	0	240
BLDG_STOR_B	581	1.05	1.35	0.00	10.00
LCA_REFPERIOD	899	55.87	17.34	20	120
EC_LCAA_PERM2	1,007	454.83	357.42	10.00	2,745.00
EC_WB_EX_OPER	1,162	415,097.20	2,331,186.00	-376.00	46,826,000.00

Table 16: Descriptive Statistics for Bldgs. less than 1000kg CO2eq.(953 obs.)

Statistic	N	Mean	St. Dev.	Min	Max
BLDG_AREA_M2	952	47,619.99	87,371.97	1.00	446,250.00
BLDG_AREA_FT2	952	512,460.90	940,053.40	10.76	4,800,936.00
BLDG_CLIM_ZN	491	4.08	1.18	1.00	7.00
BLDG_STOR_A	896	15.30	24.64	0	146
BLDG_STOR_B	488	1.12	1.38	0.00	10.00
LCA_YEAR	922	2,012.60	3.42	1,990	2,016
LCA_REFPERIOD	759	55.42	17.72	20	100
EC_WB_EX_OPER	947	294,916.70	2,380,469.00	-376.00	46,826,000.00
EC_LCAA_PERM2	953	389.23	195.50	10.00	995.00
EC_LCABCD_PERM2	266	1,159.56	2,331.36	-376.00	17,882.88
EC_WB_PERM2	948	849.61	1,380.37	-62.00	18,474.66
typical	953	1.00	0.00	1	1

Table 17: Descriptive Statistics for Bldgs. more than 1000 kg CO2eq.(54 obs.)

Statistic	N	Mean	St. Dev.	Min	Max
BLDG_AREA_M2	54	33,786.32	105,717.10	76.00	550,400.00
BLDG_AREA_FT2	54	363,669.80	1,137,929.00	817.64	5,924,451.00
BLDG_CLIM_ZN	35	3.51	1.48	1	7
BLDG_STOR_A	45	14.42	43.23	1	240
BLDG_STOR_B	6	1.17	1.60	0	4
LCA_YEAR	45	2,013.56	1.79	2,004	2,016
LCA_REFPERIOD	53	58.49	19.65	40	120
EC_WB_EX_OPER	54	50,643.50	212,479.40	84.22	1,464,614.00
EC_LCAA_PERM2	54	1,612.44	543.68	1,001.00	2,745.00
EC_LCABCD_PERM2	12	4,281.34	3,930.33	19.20	12,889.12
EC_WB_PERM2	54	2,576.52	2,773.16	1,001.00	15,354.11
typical	54	0.00	0.00	0	0

IV CORRELATION ANALYSIS

IV.A Correlation Analysis ECD (1191 Observations)

The correlation coefficient *r* measures the strength and direction of a linear relationship between two variables on a scatterplot. The value of r is always between +1 and –1, where –1 describes a perfect downhill negative linear relationship; 0. No linear relationship; +1. A perfect uphill (positive) linear relationship.

Table 18: Correlation Coefficients between categorical variables ECD

	EC_WB_EX_OPER	EC_LCAA_PERM2
BLDG_AREA_M2	-0.03640212	0.01952806
BLDG_STOR_A	-0.04587441	0.03248011
BLDG_STOR_B	-0.25519578	0.18157981
EC_WB_EX_OPER	1.0000000	-0.04188085
EC_LCAA_PERM2	-0.04188085	1.00000000

Figure 1: Color Coded Correlation Coef. between categorical variables ECD

Note: Dark blue and dark red represent strong correlations of +1 and –1 respectively, where –1 describes a perfect downhill negative linear relationship and +1. A perfect uphill (positive) linear relationship. Light blue and light red represent weaker correlations.

IV.B Cluster 1: DATABASE SCOPE SF/LCA Stage A (595 Observations)

Table 19: Correlation Coefficients between categorical variables Cluster 1

	EC_WB_EX_OPER	EC_LCAA_PERM2
BLDG_AREA_M2	0.5678114	0.07411144
BLDG_STOR_A	0.7214724	0.10219163
BLDG_STOR_B	0.1081673	0.20529350
EC_WB_EX_OPER	1.0000000	0.27070774
EC_LCAA_PERM2	0.2707077	1.00000000

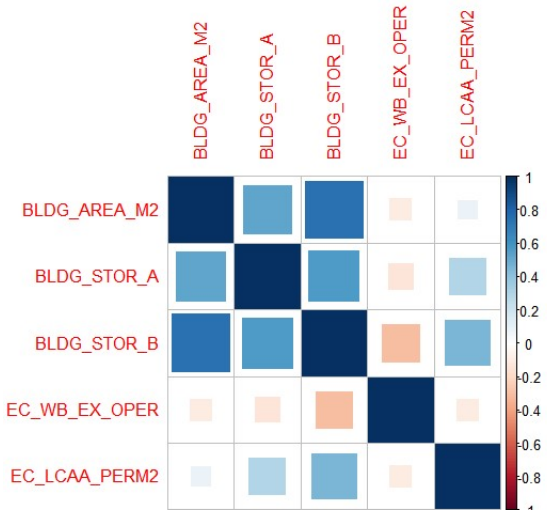
Figure 2: Color Coded Correlation Coef. between categorical variables Cluster 1

IV.C Cluster 2: DATABASE SCOPE SFEI/LCA Stage A (220 bldgs.)

Table 20: Correlation Coefficients between categorical variables Cluster 2

	EC_WB_EX_OPER	EC_LCAA_PERM2
BLDG_AREA_M2	-0.1020484	0.0808706
BLDG_STOR_A	-0.1393517	0.2970260
BLDG_STOR_B	-0.3061501	0.4588517
EC_WB_EX_OPER	1.0000000	-0.1055746
EC_LCAA_PERM2	-0.1055746	1.00000000

Figure 3: Color Coded Correlation Coef. between categorical variables Cluster 2



V Linear Regression Analysis:

```
lm(formula = EC_LCAA_PERM2 ~ BLDG_AREA_M2 + BLDG_STOR_A, data = NDB)

Residuals:
    Min      1Q  Median      3Q     Max
-436.40 -198.31  -67.42   99.43 2300.82
```

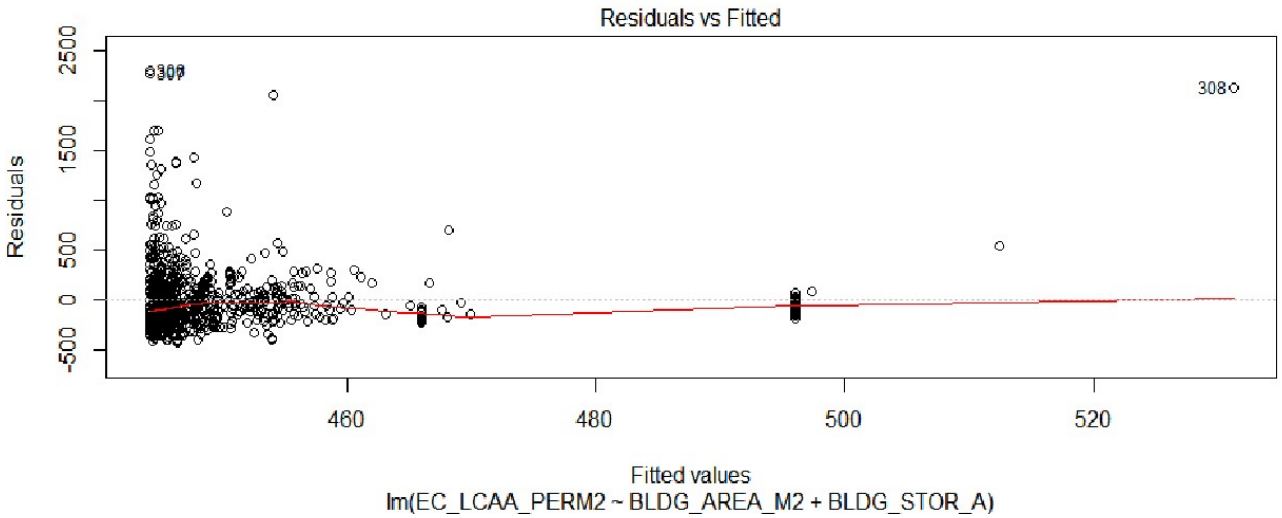
	ESTIMATE	STD. ERROR
(INTERCEPT)	4.439e+02	1.237e+01
BLDG_AREA_M2	4.943e-05	2.798e-04
BLDG_STOR_A	2.504e-01	9.843e-01
	t value	Pr(>|t|)
(INTERCEPT)	35.889	<2e-16 ***
BLDG_AREA_M2	0.177	0.860
BLDG_STOR_A	0.254	0.799

```
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’0.1 ‘ ’ 1

Residual standard error: 326.7 on 938 degrees of freedom (348 observations de
leted due to missingness)

Multiple R-squared:  0.001074, Adjusted R-squared:  -0.001056

F-statistic: 0.5041 on 2 and 938 DF,  p-value: 0.6042
```



VI ANOVA: : Two-Way Analysis of Variance (Cluster 2 SFEI Scope for LCA stage A)

In a two-way Analysis of Variance there are two independent variables or factors, which affect the dependent variable. Each factor will have two or more levels within it, and the degrees of freedom for each factor is one less than the number of levels. In this study the two independent variables will be Total building area ($BLDG_AREA_SQFT) and Number of stories below (BLDG_STOR_B), the dependent variable is Embodied Carbon in LCA Stage A (EC_LCAA_M2).

The assumptions underlying a two-way ANOVA are that the populations from which the samples were obtained must be approximately normally distributed; the samples must be independent; the variances of the populations must be equal; and the groups must have the same sample size.

Critical output for ANOVA Interpretation include the **p-value** and the **residual plots** presented as follows:

Table 21: Analysis of Variance Table

	DF	SUM SQ	MEAN SQ	F VALUE	PR(>F)
X.BLDG_AREA_M2	9	5222350	580261	5.8340	0.0000005068039
X.BLDG_STOR_A	4	1954398	488599	4.9124	0.0009191
X.BLDG_AREA_M2: X.BLDG_STOR_A	17	9534447	560850	5.6389	0.0000000006953
RESIDUALS	161	16013328	99462		0.0000005068039

Significance codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Figure 4: Residuals Fitted Values

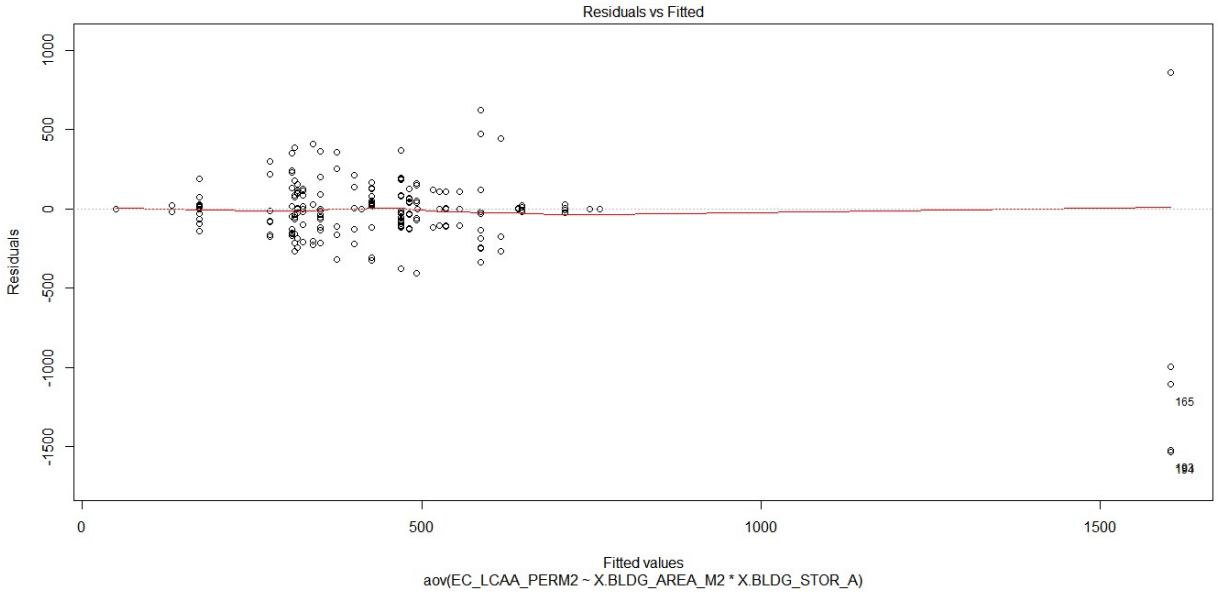
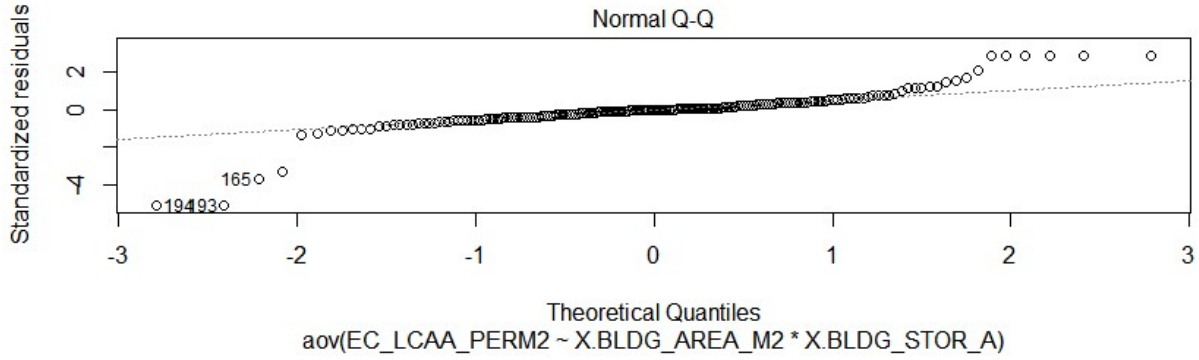


Figure 5: Standarized Residuals



VI RESULTS CONCLUSIONS

This independent research describes several Exploratory Data Analysis (EDA) techniques to analyze the Embodied Carbon Database (ECD) developed under the study 'Embodied Carbon Benchmark Study: LCA for Low Carbon Construction Project'. The database contains 1191 observations for 36 variables coming from 23 different sources. From the 36 variables, 21 are building characteristics, 11 are characteristics of the LCA study and 4 are embodied carbon indicators. In the ECD, there are 4 scalar variables, and 4 indicators.

After agregating the total database previous analysis for 'Data Quality Management' revealed that most subsets from different sources ranked poorly in Reliability and Completeness, Consistency and Comparability.

The intent of this research was to overcome the barriers of the consolidated ECD and identify trends in the data through commmon exploratory techniques such as cross tabulation analysis, correlation analysis, linear regression and a two way analysis of variance (ANOVA).

The cross tabulation analysis displays 1,191 'observations' where 1,189 observations report values for BLDG AREA (sq. ft.), 1,166 for BLDG STORIES ABOVE, and only 581 for BLDG STOR B. For Embodied Carbon Indicators 1,162 observations have values for Whole Building Embodied Carbon (excluding operational), 1,007 observations for Embodied Carbon LCA stage A and only 326 observations report values for Embodied Carbon Stages B C & D. From 1,007 observations that report EC LCA stage A, 953 report less than 1,000 kg. CO2 eq./m2 , only 54 observations report embodied carbon values larger than 1,000 kg. CO2 eq./m2.

The database identified the use of 41 different LCA Environmental Impact Sources, where the most frequently used is reported in LCA results for 322 buildings. More than half of the entries are for buildings in North America with 637 observations, followed by Europe with 212. European and North American LCA Environmental Impact Sources, however, are used for LCA studies from different geographical locations.

In order to develop a more consistent database for statistical analysis the data was clustered in smaller data groups for consistency. According to the data tabulation two important clusters (subsets) where buildings for scopes SF and SFEI.

Results indicate that for buildings in Cluster 1 (Scope SF), whole building embodied carbon (excluding operational) EC_WB_EX_OPER, exhibits a strong positive relationship to BLDG_AREA, and BLDG stories above.

For buildings in Cluster 2 (Scope SFEI), whole building embodied carbon (excluding operational) Embodied carbon LCA stage A (EC_LCAA_PERM2) exhibits a strong positive relationship only to BLDG stories below ground.

The two way ANOVA results for Cluster 2 show that the interaction between BLDG_AREA, BLDG_STOR_A and EC LCA A has no statistically significance.

The value of the ECD lies in the large number of buildings LCA records available for all scopes and different life cycle stages, however the data aggregation from different subsets is not conducive to a

consistent dataset such as the one required for statistical inference. Common errors are data-entry mistakes, omissions, transpositions where correct entries are located under wrong dataset variables, or interpretation. For instance, from the subgroup of buildings reporting Embodied Carbon Life Cycle Stage A (EC_LCAA_M2) some sources consider Stage A only as manufacturing while other sources consider construction activities as well (A1-A5). An inconsistent dataset presents obvious challenges to useful inferences and thus can distort the identification of statistical patterns, essential for benchmark studies.

Another important aspect is how the representativeness of the data for regional or specific building sample defined by use or type. The data presented through the ECD comes from case studies where the data was available, however these are not representative of the full building market. In sum, the following conclusion can be presented from this study:

- There is an urgent need to standarize general buidling design data and building life cycle assessment data. Alignment in definitions of building area (gross, internal or exterior), building life cycle stages and scopes are critical for comparison.
- Further research is needed to develop larger samples that represent the commercial and residential building stock.

The following phase of this independent research project will focus on expanding data consistency and extension, by including on one hand statistical strategies to address inconsistency in the existing database and on the other hand, to enlarge the ECD with new data entries.

R CODE

```
# Description: Tables of descriptive statistics for

# Embodied Carbon Data


#=============================================================================

#   1. Settings, packages, and options

#=============================================================================


# Recommended Commands run all of the commands in Section 1

# at the start of every R session.


 # Clear the working space

 rm(list = ls())


 # Set working directory (edit for YOUR econ 42 folder)

 setwd("c:/R Files/CLF_1191_12.15.csv")


 # Load the packages

 install.packages("AER")

 install.packages("car")

 install.packages("countrycode")

 install.packages("doBy")

 install.packages("dplyr")

 install.packages("foreign")

 install.packages("gdata")

 install.packages("ggplot2")

 install.packages("knitr")

 install.packages("lmtest")

 install.packages("openintro")
```

```
install.packages("OIdata")
install.packages("readstata13")
install.packages("reshape")
install.packages("sandwich")
install.packages("stargazer")
install.packages("WDI")
install.packages("XML")

library(AER)
library(car)
library(countrycode)
library(doBy)
library(dplyr)
library(foreign)
library(gdata)
library(ggplot2)
library(knitr)
library(lmtest)
library(openintro)
library(OIdata)
library(readstata13)
library(reshape)
library(sandwich)
library(stargazer)
library(WDI)
library(XML)

# turn off scientific notation except for big numbers
options(scipen = 9)
```

```
 # set larger font size for qplot (default is 12)
 theme_set(theme_gray(base_size = 18))
 # function to calculate corrected SEs for regression
 cse = function(reg) {
  rob = sqrt(diag(vcovHC(reg, type = "HC1")))
  return(rob)
 }


#=============================================================================
#   2. Data section
#=============================================================================

### Read data
 # Data input using read.csv
 NDB <- read.csv(file="c:/R Files/CLF_1191_12.15.csv", strip.white=TRUE)
 summary(NDB)
 summary(NDB$BLDG_TYP)
 summary(NDB$BLDG_LOC_REGION)
 summary(NDB$BLDG_NEW_REN)
 summary(NDB$X.BLDG_YEAR)
 summary(NDB$BLDG_STRUC)
 summary(NDB$X.BLDG_STOR_A)
 summary(NDB$BLDG_STOR_B)
 head(NDB)

 # new variable for "Typical" embodied carbon < 1000 CO2 eq.
 # Note "address" for a variable is the data frame name, then the dollar sign $, then the variable name
 # Note this variable is a "factor" variable, not a numeric variable
```

```
NDB$typical <- NDB$EC_LCAA_PERM2< 1000

#============================================================================
#   3. Analysis section
#============================================================================

 # 2-Way Frequency Table for Bldg Characteristics
 attach(NDB)
 mytable <- table(BLDG_US,BLDG_TYP) # A will be rows, B will be columns
 mytable # print table
 write.table(mytable, file = "br1.txt", sep = ",", quote = FALSE)

 mytable <- table(BLDG_US,BLDG_LOC_REGION) # A will be rows, B will be columns
 mytable # print table
 write.table(mytable, file = "br1.txt", sep = ",", quote = FALSE)

 mytable <- table(BLDG_US,BLDG_NEW_REN) # A will be rows, B will be columns
 mytable # print table
 write.table(mytable, file = "br1.txt", sep = ",", quote = FALSE)

 mytable <- table(BLDG_US,X.BLDG_YEAR) # A will be rows, B will be columns
 mytable # print table
 write.table(mytable, file = "br1.txt", sep = ",", quote = FALSE)

 mytable <- table(BLDG_US,BLDG_STRUC) # A will be rows, B will be columns
 mytable # print table
 write.table(mytable, file = "br1.txt", sep = ",", quote = FALSE)

 mytable <- table(BLDG_US,X.BLDG_STOR_A) # A will be rows, B will be columns
```

```
mytable # print table
write.table(mytable, file = "br1.txt", sep = ",", quote = FALSE)

mytable <- table(BLDG_US,BLDG_STOR_B) # A will be rows, B will be columns
mytable # print table
write.table(mytable, file = "br1.txt", sep = ",", quote = FALSE)



# 2-Way Frequency Table For BLDG LCA data
attach(NDB)

mytable <- table(LCA_SOUR_CODE, BLDG_TYP) # A will be rows, B will be columns
mytable # print table
write.table(mytable, file = "br1.txt", sep = ",", quote = FALSE)

mytable <- table(LCA_SOUR_CODE, BLDG_LOC_REGION) # A will be rows, B will be columns
mytable # print table
write.table(mytable, file = "br1.txt", sep = ",", quote = FALSE)

mytable <- table(BLDG_TYP, LCA_YEAR) # A will be rows, B will be columns
mytable # print table
write.table(mytable, file = "br1.txt", sep = ",", quote = FALSE)

mytable <- table(LCA_BLDG_SCOPE,LCA_STAGES) # A will be rows, B will be columns
mytable # print table
write.table(mytable, file = "br1.txt", sep = ",", quote = FALSE)

mytable <- table(BLDG_US,LCA_REFPERIOD) # A will be rows, B will be columns
```

```
mytable # print table
write.table(mytable, file = "br1.txt", sep = ",", quote = FALSE)

mytable <- table(BLDG_US,LCA_REFPERIOD) # A will be rows, B will be columns
mytable # print table
write.table(mytable, file = "br1.txt", sep = ",", quote = FALSE)



# frequency tables by region, various permutations
table(NDB$X.BLDG_AREA_FT2)
table(NDB$BLDG_US, NDB$X.BLDG_AREA_FT2)
table(NDB$LOC_REGION, NDB$typical, useNA="ifany")



### Descriptive statistics for ECD

# Standard descriptive statistics for all numerical variables in the data
stargazer(NDB, type="text", median=TRUE, title=" Table 2: Descriptive Statistics Embodied Carbon Dataset")
write.table(mytable, file = "br1.txt", sep = ",", quote = FALSE)

# Descriptive statistics for selected variables
stargazer(NDB[c("BLDG_AREA_M2","BLDG_AREA_FT2","BLDG_STOR_A", "BLDG_STOR_B", "LCA_REFPERIOD", "EC_LCAA_PERM2", "EC_WB_EX_OPER")], type="text", digits=2, title="Table 2: Descriptive Statistics Embodied Carbon Dataset")

# Descriptive statistics for a subset of observations
stargazer(subset(NDB, typical==1), type="text", digits=2, title="Table 3: Descriptive Statistics for Buildings less than 1000 kg CO2eq.")
```

```
stargazer(subset(NDB, typical==0), type="text", digits=2, title="Table 4: Descriptive Statistics for Buildings more than 1000 kg CO2eq.")



# Correlation Analysis EDB
NDB <- read.csv(file="c:/R Files/CLF_1191_12.15.csv", strip.white=TRUE)
mydata <- sapply(NDB, is.numeric)
cor(NDB[,c(12,19,21,33,34)], use="pairwise.complete.obs")
mytable <- table(cor(NDB[,mydata], use="complete.obs"))
write.table(mytable, file = "br1.txt", sep = ",", quote = FALSE)

install.packages("corrplot")
library(corrplot)
M <-  cor(NDB[,c(12,19,21,33,34)], use="pairwise.complete.obs")
corrplot(M, method= "square")

mydata[,c(14,19,21,34)]
pairs.default(mydata)



# Correlation Analysis Cluster 1
NDB <- read.csv(file="c:/R Files/CLF_1191_12.15_A&SF.csv", strip.white=TRUE)
mydata <- sapply(NDB, is.numeric)
cor(NDB[,c(12,19,21,33,34)], use="pairwise.complete.obs")
mytable <- table(cor(NDB[,mydata], use="pairwise.complete.obs"))
write.table(mytable, file = "br1.txt", sep = ",", quote = FALSE)

install.packages("corrplot")
```

```
library(corrplot)
M <- cor(NDB[,c(12,19,21,33,34)], use="pairwise.complete.obs")
corrplot(M, method= "square")

mydata[,c(14,19,21,34)]
pairs.default(mydata)

# Correlation Analysis Cluster 2
NDB <- read.csv(file="c:/R Files/CLF_1191_12.15_A&SFEI.csv", strip.white=TRUE)
mydata <- sapply(NDB, is.numeric)
cor(NDB[,c(12,19,21,33,34)], use="pairwise.complete.obs")
mytable <- table(cor(NDB[,c(12,19,21,33,34)], use="pairwise.complete.obs")
write.table(mytable, file = "br1.txt", sep = ",", quote = FALSE)

install.packages("corrplot")
library(corrplot)
M <- cor(NDB[,c(12,19,21,33,34)], use="pairwise.complete.obs")
corrplot(M, method= "square")

mydata[,c(14,19,21,34)]
pairs.default(mydata)


# ANOVA two way factorial design
TWNDB <- read.csv(file="c:/R Files/CLF_1191_12.15_A&SFEI.csv", strip.white=TRUE)
TWNDB

#use anova(object) to test the omnibus hypothesis
#Are main effects or interaction effects present in the independent variables?
```

```
anova(lm(EC_LCAA_PERM2 ~ X.BLDG_AREA_M2 * X.BLDG_STOR_A, TWNDB))
fit <- aov(EC_LCAA_PERM2 ~ X.BLDG_AREA_M2 * X.BLDG_STOR_A, data= TWNDB)
plot(fit)

#use subset(data, condition) to divide the original dataset along the groups
#1 to 6 subset
onetosix <- subset(TWNDB, X.BLDG_STOR_A == "1 to 6")
#7 to 15 subset
seventofifteen <- subset(TWNDB, X.BLDG_STOR_A == "7 to 14")
#15 to 25 subset
fifteentotwentyfive <- subset(TWNDB, X.BLDG_STOR_A == "15 to 25")

#medical
anova(lm(EC_LCAA_PERM2 ~ X.BLDG_AREA_M2, onetosix))
anova(lm(EC_LCAA_PERM2 ~ X.BLDG_AREA_M2, seventofifteen))
anova(lm(EC_LCAA_PERM2 ~ X.BLDG_AREA_M2, fifteentotwentyfive))
```

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CARBON LEADERSHIP FORUM

Embodied Carbon Benchmark Study

LCA for Low Carbon Construction Project

APPENDIX D: Data Quality Assessment

DATA QUALITY SUMMARY

"Embodied Carbon Benchmark Study: LCA for Low Carbon Construction Project"

PI: Kathrina Simonen

Stefanie Barrera

Barbara Rodriguez Droguett Program, Built Environment PhD Program

December 16, 2016

Contents

I SCOPE AND OBJECTIVES

This appendix aims to summarize the findings from Stage 2: Data Quality Assessment, in the project 'Life Cycle Assessments for Low Carbon Construction Stage 1: Embodied Carbon Benchmarks'. The objective of the Data Quality Assessment is to identify entries of both low quality/confidence and outside the statistical range, therefore a data quality assessment is performed for each dataset obtained from each separate source.

II METHODOLOGY

The methodology is based on a quality check matrix where each data source was assessed for *relevance, timeliness, completeness, coherence and comparability,* as shown in Table 1:

Table 1: Data Quality Pedigree Matrix

INDICATOR SCORE	**1**	**2**	**3**	**4**	**5**
Reliability (adapted from Weidema and Wesnaes, 1996)	Verified data based on internally generated comprehensive LCA. Follows ISO Documented Reviewed. Generated LCI models	Verified data partly based on external LCA tool/dataset or non-verified data based on internally generated comprehensive LCA. Documentation included.	Non-verified data partly based on assumptions (external LCA tool/dataset) with documentation.	Qualified Estimate (e.g. by industry expert) Results summarized but not method not documented.	Non-qualified estimate
Completeness	Data completed for all the variables under our study	Data completed for > 50% of the variables under our study	Data completed for only some of the variables under our study	Data completed for only three of the variables under our study	Data completed for less than three of the variables under our study
Temporal Correlation (Weidema and Wesnaes, 1996)	Age of 70% of data less than 3 years of difference to year of study.	Age of 70% of data less than six years difference.	Age of 70% of data less than 10 years difference.	Age of 70% of data less than 15 years difference.	Age of 70% of data unknown or more than 15 years difference.
Consistency	All data assessed follows the same format and record across the dataset	> 50% data assessed follows the same format and record across the dataset	> 20% data assessed follows the same format and record across the dataset	> 5% data assessed follows the same format and record across the dataset	Data assessed does not follow the same format and record across the dataset
Comparability	All data variables match existing benchmarking studies variables.	> 50 %data variables match existing benchmarking studies variables.	>20% data variables match existing benchmarking studies variables.	>5% data variables match existing benchmarking studies variables.	Data variables do not match existing benchmarking studies names.

The first step was to assess the 36 variables (i.e. bldg. area, embodied carbon LCA stage A) in the existing data source. Every data quality parameter was measured in a scale from 1 to 5, where the final score of 25 was considered poor database quality and a score of 5, high database quality. The second step of the data quality assessment was to distribute the reports back to the organizations that donated databases. A third step involved getting feedback from the data sources and remove suspect data points from the database.

III RESULTS

Table 2: Final scores by dataset

	RELIABILITY	COMPLETENESS	TEMPORAL CORRELATION	CONSISTENCY	COMPARABILITY	TOTAL
A01	5	3	3	2	2	15
A02	3	3	1	1	1	9
A03	5	3	5	1	4	18
A04	3	2	4	4	4	17
A050	4	2	2	5	5	18
A051	4	2	1	5	5	17
A052	4	2	3	5	5	19
A053	5	2	5	5	5	22
A054	5	2	2	5	5	19
A055	4	3	5	5	5	22
A056	5	2	1	5	5	18
A057	5	2	1	5	5	18
A058	5	2	4	5	5	21
A059	4	2	1	5	5	17
A0591	5	2	3	5	5	20
A0592	4	2	2	5	5	18
A0593	3	2	2	5	5	17
A0594	4	2	2	5	5	18
A0595	4	2	1	5	5	17
A0596	4	2	5	5	5	21
A0597	5	2	3	5	5	20
A0598	5	2	1	5	5	18
A0599	5	2	4	5	5	21

INDIVIDUAL DATASET ANALYSIS EXAMPLES

Data Quality Assessment Worksheet				
Dataset ID:	A01	Data Source:	XXXX	
Number of Observations:	**118**	**No of Variables:**	**108**	
Number of Variables Transcribed from Original Dataframe:			14	
Number of Variables Adapted from Original Dataframe:			20	
Total Number of Variables Assessed:			34	(includes interval and cat variables)
Date Reviewed:	July 22nd 2016			
ASSESSMENT SUMMARY TABLE		Total Score	15	

Criteria	Definition	Score	Explanation
RELIABILITY	Does data come from a verifiable source?	5	Non-qualified estimate
COMPLETENESS	Does data include all necessary fields that the database is intended to compile?	3	Data completed for > 50% of the variables under our study
TEMPORAL CORRELATION	Is data timely enough to provide accurate results?	3	Age of 70% of data less than 10 years difference.
CONSISTENCY	Are the relations between observations and variables consistent within the database?	2	> 50% data assessed follows the same format and record across the dataset
COMPARABILITY	Do data variables match existing building benchmarking data?	2	> 50 %data variables match existing benchmarking studies variables.

Data Quality Assessment Worksheet				
Dataset ID:	A02	Data Source:	XXXX	
Number of Observations:	**313**	**No of Variables:**	**106**	
Number of Variables Transcribed from Original Dataframe:			8	
Number of Variables Adapted from Original Dataframe:			26	
Total Number of Variables Assessed:			34	(includes interval and cat variables)
Date Reviewed:	July 22nd 2016			
ASSESSMENT SUMMARY TABLE		Total Score	9	

Criteria	Definition	Score	Explanation
RELIABILITY	Does data come from a verifiable source?	3	Non-verified data partly based on assumptions (external LCA tool/dataset) with documentation.
COMPLETENESS	Does data include all necessary fields that the database is intended to compile?	3	Data completed for only some of the variables under our study
TEMPORAL CORRELATION	Is data timely enough to provide accurate results?	1	Age of 70% of data less than 3 years of difference to year of study.
CONSISTENCY	Are the relations between observations and variables consistent within the database?	1	All data assessed follows the same format and record across the dataset
COMPARABILITY	Do data variables match existing building benchmarking data?	1	All data variables match existing benchmarking studies variables.

Data Quality Assessment Worksheet					
Dataset ID:	A03	Data Source:	XXXX		
Number of Observations:	**18**	**No of Variables:**	**7**		
Number of Variables Transcribed from Original Dataframe:			6		
Number of Variables Adapted from Original Dataframe:			26		
Total Number of Variables Assessed:			34	(includes interval and cat variables)	
Date Reviewed:	July 22nd 2016				
ASSESSMENT SUMMARY TABLE		Total Score	18		
Criteria	Definition		**Score**	Explanation	
RELIABILITY	Does data come from a verifiable source?		**5**	Non-qualified estimate	
COMPLETENESS	Does data include all necessary fields that the database is intended to compile?		**3**	Data completed for only some of the variables under our study	
TEMPORAL CORRELATION	Is data timely enough to provide accurate results?		**5**	Age of 70% of data unknown or more than 15 years difference.	
CONSISTENCY	Are the relations between observations and variables consistent within the database?		**1**	All data assessed follows the same format and record across the dataset	
COMPARABILITY	Do data variables match existing building benchmarking data?		**4**	> 5% data variables match existing benchmarking studies variables.	

Data Quality Assessment Worksheet					
Dataset ID:	A04	Data Source:	XXXX		
Number of Observations:	**553**	**No of Variables:**	**106**		
Number of Variables Transcribed from Original Dataframe:			17		
Number of Variables Adapted from Original Dataframe:			17		
Total Number of Variables Assessed:			34	(includes interval and cat variables)	
Date Reviewed:	July 11th 2016				
ASSESSMENT SUMMARY TABLE		Total Score	17		
Criteria	Definition		**Score**	Explanation	
RELIABILITY	Does data come from a verifiable source?		**3**	Non-verified data partly based on assumptions (external LCA tool/dataset) with documentation.	
COMPLETENESS	Does data include all necessary fields that the database is intended to compile?		**2**	Data completed for > 50% of the variables under our study	
TEMPORAL CORRELATION	Is data timely enough to provide accurate results?		**4**	Age of 70% of data is less than 15 years difference.	
CONSISTENCY	Are the relations between observations and variables consistent within the database?		**4**	> 5% data follows the same format and record across the dataset	
COMPARABILITY	Do data variables match existing building benchmarking data?		**4**	> 5% data variables match existing benchmarking studies variables.	

Data Quality Assessment Worksheet				
Dataset ID:	A050	Data Source:		
Number of Observations:	**24**	**No of Variables:**	Varied table to table	
Number of Variables Transcribed from Original Dataframe:			12	
Number of Variables Adapted from Original Dataframe:			14	
Total Number of Variables Assessed:			27	
Reviewer:	SB			
Date Reviewed:	11/19/2016			

ASSESSMENT SUMMARY TABLE		Total Score	18
Criteria	Definition	**Score**	Explanation
RELIABILITY	Does data come from a verifiable source?	**4**	Qualifed Estimate (eg. by industry expert). Results summarized but not method not documented
COMPLETENESS	Does data include all necessary fields that the database is intended to compile?	**2**	Data completed for >50% of the variables under our study
TEMPORAL CORRELATION	Is data timely enough to provide accurate results?	**2**	Less than six years difference
CONSISTENCY	Are the relations between observations and variables consistent within the database?	**5**	Data assessed does not follow the same format and record across the dataset.
COMPARABILITY	Do data variables match existing building benchmarking data?	**5**	Data variales do not match existing benchmark studies names.

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CARBON LEADERSHIP FORUM

Embodied Carbon Benchmark Study

LCA for Low Carbon Construction Project

APPENDIX E: Workshop Results

LCA for Low Carbon Construction: **Embodied Carbon Benchmark**

LIMITATIONS & SOURCES OF UNCERTAINTY

Larry

The following preliminary limitations to the Embodied Carbon Benchmark findings are noted below.

Please review and discuss within your group.

Please review this list and add any additional issues your team identifies. Delete any you don't feel are relevant. Rank the importance of each of the different issue. (High, medium and low level of importance)

LIMITATIONS	HIGH	MED	LOW	NOTES
1. The data reports only initial embodied carbon, not maintenance, energy use or end of life.		X		
2. It is not appropriate to use this database to make comparative assertions between building types or categories.	X			
3. This database is compiled of data available to the research team, a 'sample of convenience.'		X		
4. This database is not a statistically representative sample of current building practices. include variability within bldg typs		X		need more small, light bldgs
5. include occupancy # of occupants				# of stories # of Data point
6. Sequestration – include				
7. put multi story Res with the rest				
8. is this the best way to do this? Have whole bldg LCA to do model projects				

LCA for Low Carbon Construction: **Embodied Carbon Benchmark**

LIMITATIONS & SOURCES OF UNCERTAINTY

The following preliminary limitations to the Embodied Carbon Benchmark findings are noted below.

Please review and discuss within your group.

Please review this list and add any additional issues your team identifies. Delete any you don't feel are relevant. Rank the importance of each of the different issue. (High, medium and low level of importance)

LIMITATIONS	HIGH	MED	LOW	NOTES
1. The data reports only initial embodied carbon, not maintenance, energy use or end of life.	X			
2. It is not appropriate to use this database to make comparative assertions between building types or categories.			X	comparing building type to building type can be useful @ a policy level (zoning)
3. This database is compiled of data available to the research team, a 'sample of convenience.'			X	
4. This database is not a statistically representative sample of current building practices.				
5.				
6.				
7.				
8.				

LCA for Low Carbon Construction: **Embodied Carbon Benchmark**

LIMITATIONS & SOURCES OF UNCERTAINTY

The following preliminary limitations to the Embodied Carbon Benchmark findings are noted below. LCA Group

Please review and discuss within your group.

Please review this list and add any additional issues your team identifies. Delete any you don't feel are relevant. Rank the importance of each of the different issue. (High, medium and low level of importance)

LIMITATIONS	HIGH	MED	LOW	NOTES
1. The data reports only initial embodied carbon, not maintenance, energy use or end of life.			✓	This is embodied.
2. It is not appropriate to use this database to make comparative assertions between building types or categories.	✓			uninformed users might jump to conclusions, so it needs to be entirely reanalyzed
3. This database is compiled of data available to the research team, a 'sample of convenience.'				
4. This database is not a statistically representative sample of current building practices.				
5.				
6.				
7.				
8.				

LCA for Low Carbon Construction: **Embodied Carbon Benchmark**

LIMITATIONS & SOURCES OF UNCERTAINTY

The following preliminary limitations to the Embodied Carbon Benchmark findings are noted below.

Please review and discuss within your group.

Please review this list and add any additional issues your team identifies. Delete any you don't feel are relevant. Rank the importance of each of the different issue. (High, medium and low level of importance)

LIMITATIONS	HIGH	MED	LOW	NOTES
1. The data reports only initial embodied carbon, not maintenance, energy use or end of life.				
2. It is not appropriate to use this database to make comparative assertions between building types or categories.				
3. This database is compiled of data available to the research team, a 'sample of convenience.'				
4. This database is not a statistically representative sample of current building practices.				
5.				
6.				
7.				
8.				

LCA for Low Carbon Construction: **Embodied Carbon Benchmark**

Bmb.

SOURCES OF UNCERTAINTY	HIGH	MED	LOW	NOTES
a. LCA scope (life cycle stages and calculation methodology) are not aligned.		✓		1) Do not a high uncertainty since LCA steps are standardized
b. Building Scope (extent of building modeled) is not consistent.		✓		1) High for scope D
c. Life Cycle Inventory datasets not consistent or aligned.	✓			1) HUGELY HIGH
d. Building area not consistently defined (gross, net, interior etc.)			✓	1) Quick check
e. Foundation impacts large and soil conditions have large variability/not tracked.		✓		
f. Regional variation not included (climate, hazard zone)		✓		
g. Data quality uncertain/greatly varied.	✓			
h.				
i.				
j.				
k.				
l.				
m.				

LCA for Low Carbon Construction: **Embodied Carbon Benchmark**

SOURCES OF UNCERTAINTY	HIGH	MED	LOW	NOTES
a. LCA scope (life cycle stages and calculation methodology) are not aligned.	✓			
b. Building Scope (extent of building modeled) is not consistent.	↓			
c. Life Cycle Inventory datasets not consistent or aligned.	↓			
d. Building area not consistently defined (gross, net, interior etc.)	↓			
e. Foundation impacts large and soil conditions have large variability/not tracked.	↓			
f. Regional variation not included (climate, hazard zone)	↓			
g. Data quality uncertain/greatly varied.	↓			
h.				
i.				
j.				
k.				
l.				
m.				

LCA for Low Carbon Construction: **Embodied Carbon Benchmark**

SOURCES OF UNCERTAINTY	HIGH	MED	LOW	NOTES
a. LCA scope (life cycle stages and calculation methodology) are not aligned.				
b. Building Scope (extent of building modeled) is not consistent.				
c. Life Cycle Inventory datasets not consistent or aligned.				
d. Building area not consistently defined (gross, net, interior etc.)				
e. Foundation impacts large and soil conditions have large variability/not tracked.				
f. Regional variation not included (climate, hazard zone)				
g. Data quality uncertain/greatly varied.				
h.				
i.				
j.				
k.				
l.				
m.				

LCA for Low Carbon Construction: **Embodied Carbon Benchmark**

SOURCES OF UNCERTAINTY	HIGH	MED	LOW	NOTES
a. LCA scope (life cycle stages and calculation methodology) are not aligned.				
b. Building Scope (extent of building modeled) is not consistent.				
c. Life Cycle Inventory datasets not consistent or aligned.				
d. Building area not consistently defined (gross, net, interior etc.)				
e. Foundation impacts large and soil conditions have large variability/not tracked.				
f. Regional variation not included (climate, hazard zone)				
g. Data quality uncertain/greatly varied.				
h.				
i.				
j.				
k.				
l.				
m.				

LCA for Low Carbon Construction: **Embodied Carbon Benchmark**

PRELIMINARY FINDINGS

Review the data presented in Plots 1, 2 & 3 and limitations noted on attached sheet
Discuss within your group
Identify key issues/edit the text as needed to increase level of agreement.
Initial to confirm your level of agreement and note any key issues of disagreement.

LCA Group!

PROPOSED FINDINGS	AGREE	DISAGREE	NOTES
1. The data presented represents a reasonable order of magnitude and range of variation in estimating the embodied carbon footprint of buildings.		✓	1. Example: Plot 2A, B column, C column < A column 2. Sample sizes for certain categori 3. Inconsistent patterns 4. Should be compared by source 5. Should create some 'model' projec to add to the mix 6. Analyze data to determine 'good/ better' points 7. Consider 'Cradle to cx' 8. Have quantity surveyors go to the best buildings and do a full, neutral assessment so the numbers are accurate.
2. The embodied carbon of a building is typically less than _____ $kgCO2_e/m^2$			
3. For commercial office buildings, the range of embodied carbon for building scope D is typically between _____ and _____ $kgCO2_e/m^2$.			
4. For small residential buildings (less than 6 stories tall) the range of embodied carbon for building scope D is typically between _____ and _____ $kgCO2_e/m^2$.			

LCA for Low Carbon Construction: **Embodied Carbon Benchmark**

PRELIMINARY FINDINGS

Barb.

Review the data presented in Plots 1, 2 & 3 and limitations noted on attached sheet
Discuss within your group
Identify key issues/edit the text as needed to increase level of agreement.
Initial to confirm your level of agreement and note any key issues of disagreement.

PROPOSED FINDINGS	AGREE	DISAGREE	NOTES
1. The data presented represents a reasonable order of magnitude and range of variation in estimating the embodied carbon footprint of buildings.	✓	AALL	1.) Find a statistically representative sample 2.) comments 3) communicate the results for different bldgs 4) Agreement only for 4 to C
2. The embodied carbon of a building is typically less than 800 $kgCO2_e/m^2$	✓		1.) Establish a benchmark for each bldg use
3. For commercial office buildings, the range of embodied carbon for building scope D is typically between 50 and 1200? $kgCO2_e/m^2$.	✓		1) The bldgs scopes are not in the same range to agree everybody should detail 2) Explore the data to determine upper bound 3) There should be a different of new – renovated ... conversion 4) Show bldg scopes 1–5...... confusing!
4. For small residential buildings (less than 6 stories tall) the range of embodied carbon for building scope D is typically between 50 and 500 $kgCO2_e/m^2$.	✓		5) Student project 6) not enough data to decide accurately

LCA for Low Carbon Construction: **Embodied Carbon Benchmark**

PRELIMINARY FINDINGS

#min

Review the data presented in Plots 1, 2 & 3 and limitations noted on attached sheet
Discuss within your group
Identify key issues/edit the text as needed to increase level of agreement.
Initial to confirm your level of agreement and note any key issues of disagreement.

PROPOSED FINDINGS	AGREE	DISAGREE	NOTES
1. The data presented represents a reasonable order of magnitude and range of variation in estimating the embodied carbon footprint of buildings.	Yes		concern w/ duplicates scopes don't include TI, for ex. mechanical? Biogenic? How do individual ~~projects~~ product EPDs w/ different LCA stages than A get counted
2. The embodied carbon of a building is typically less than 1,000 $kgCO2_e/m^2$	Yes		Better to rewrite as: The embodied carbon of a building, cradle-to-gate is typically less than 1,000 $kgCO_2e/m^2$.
3. For commercial office buildings, the range of embodied carbon for building scope D is typically between _____ and _____ $kgCO2_e/m^2$.	No		1) look at ~~drop~~ duplicate data 2) ~~drop~~ look at theoretical buildings (?) 3) look at 'strong' data points (quality) 4) sort by LCI data source 5) year of study 6) Material quantities reported same apply?
4. For small residential buildings (less than 6 stories tall) the range of embodied carbon for building scope D is typically between _____ and _____ $kgCO2_e/m^2$.	No		small multifamily → not enough data

↳ separate out single family vs. multifamily

LCA for Low Carbon Construction: **Embodied Carbon Benchmark**

PRELIMINARY FINDINGS

lam

Review the data presented in Plots 1, 2 & 3 and limitations noted on attached sheet
Discuss within your group
Identify key issues/edit the text as needed to increase level of agreement.
Initial to confirm your level of agreement and note any key issues of disagreement.

PROPOSED FINDINGS	AGREE	DISAGREE	NOTES
1. The data presented represents a reasonable order of magnitude and range of variation in estimating the embodied carbon footprint of buildings.	yes		check variability of building types Hua
2. The embodied carbon of a building is typically less than 800 $kgCO2_e/m^2$			
3. For commercial office buildings, the range of embodied carbon for building scope D is typically between _____ and _____ $kgCO2_e/m^2$.			what is anomaly above the line in D for offices? occupancy
4. For small residential buildings (less than 6 stories tall) the range of embodied carbon for building scope D is typically between 125 and 225 $kgCO2_e/m^2$.			

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CARBON LEADERSHIP FORUM

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APPENDIX F: Advisory Committee Survey

Survey Question Preview

Survey Statistical Results

Written Responses

Survey Participants

10 Architect/Engineer/Contractor

2 Consultant

4 LCA Professional

5 Research/Academic

3 Government/NGO

2 Student w/LCA background

Embodied Carbon Benchmark Advisory Committee

Thank you for participating as an adviser to the Embodied Carbon Benchmark Project.

Please read the report draft dated 1/13/2017 before completing the survey.

Have fun exploring the draft Data Visualization!

Question 1.
Please asses your level of confidence with the following statements acknowledging the limitations noted in the report draft **(PAGE 20)**. Note the third and fourth statement have changed slightly since the December draft/January conference calls.

	High Confidence	Confident	Neutral	Low Confidence	Disagree
The data presented in the RESEARCH database represents a reasonable order of magnitude and range of variation of estimates of the embodied carbon footprint of buildings.	○	○	○	○	○
The initial embodied carbon (LCA stage A) of a building's structure, foundation and enclosure is typically less than 1,000 kgCO2e/m2.	○	○	○	○	○
The initial embodied carbon (LCA stage A) of low-rise (less than 7 story) residential building's structure, foundation and enclosure is typically less than 500 kgCO2e/m2 however there is not sufficient data to state ranges with confidence.	○	○	○	○	○
For commercial office buildings, the range of initial embodied carbon (LCA stage A)					

for building structure, foundation and enclosure is between 200 and 500 kg CO2e/m2 for 50% of buildings in the database.	○	○	○	○	○

Next >>

Questions or Comments?
Contact KATHRINA L SIMONEN at ksimonen@u.washington.edu

Embodied Carbon Benchmark Advisory Committee

For the next three questions, please refer to **SECTION 5.2 of REPORT** for project definitions.

Rank in level of **VALUE TO THE BUILDING INDUSTRY** as a whole according to these criteria:

- Critical (must be done first to enable future research)
- Essential (data/tools needed now and valuable to a wide audience)
- Valuable (worth doing after more essential work is complete)
- Neutral (not sufficiently useful to prioritize)
- Not Important (low perceived benefit)

Question 2.
STANDARDIZING PRACTICE (pg 21)

	Critical	Essential	Valuable	Neutral	Not Important
P1: LCA Practice Guide	○	○	○	○	○
P2: LCA Baseline Building Guidance (LEED v4)	○	○	○	○	○
P3: Building Industry Dataset (aligned/open source)	○	○	○	○	○
P4: Define Reference/Benchmark Building	○	○	○	○	○
P5: Lifespan Standardization	○	○	○	○	○

Question 3.
GENERATING LCA DATA (page 22)

	Critical	Essential	Valuable	Neutral	Not Important
L1: Standardized Building Models	○	○	○	○	○
L2: Housing LCA	○	○	○	○	○
L3: Data/Tool Comparison	○	○	○	○	○
L4: Material Quantity Reporting	○	○	○	○	○
L5: Building					

Scale/Construction Trends	○	○	○	○	○
L6: Evaluating the Known Unknowns of Building LCA	○	○	○	○	○
L7: Evaluating Subgrade Construction, Parking and Foundations	○	○	○	○	○
L8: Regional Variation	○	○	○	○	○

Question 4.
DEVELOPING GUIDANCE (page 23)

	Critical	Essential	Valuable	Neutral	Not Important
G1: Re-use/Retrofit/New	○	○	○	○	○
G2: National Industry Implications	○	○	○	○	○
G3: Office Building Benchmarks	○	○	○	○	○

[<< Previous](#) **[Next >>](#)**

Questions or Comments?
Contact KATHRINA L SIMONEN at ksimonen@u.washington.edu

Embodied Carbon Benchmark Advisory Committee

Please rank the top three projects that would be most valuable to enabling:

YOUR LCA PRACTICE &/OR YOUR USE OF LCA DATA IN PRACTICE

Question 5.
Which research project would you identify as your FIRST priority?

- P1: LCA Practice Guide
- P2: LCA Baseline Building Guidance (LEED v4)
- P3: Building Industry LCA Dataset (aligned/open source)
- P4: Define Reference/Benchmark Building
- P5: Lifespan Standardization
- L1: Standardized Building Models
- L2: Housing LCA
- L3: Data/Tool Comparison
- L4: Material Quantity Reporting
- L5: Building Scale/Construction Trends
- L6: Evaluate the Known Unknowns of Building LCA
- L7: Evaluate Subgrade Construction, Parking and Foundations
- L8: Regional Variation
- G1: Re-Use/Retrofit/New
- G2: National Industry Implications
- G3: Office Building Benchmarks

Question 6.

Explain why you selected this project as your first priority.

Question 7.
Which research project would you identify as your SECOND priority?

- P1: LCA Practice Guide
- P2: LCA Baseline Building Guidance (LEED v4)
- P3: Building Industry LCA Dataset (aligned/open source)
- P4: Define Reference/Benchmark Building
- P5: Lifespan Standardization
- L1: Standardized Building Models
- L2: Housing LCA
- L3: Data/Tool Comparison
- L4: Material Quantity Reporting
- L5: Building Scale/Construction Trends
- L6: Evaluate the Known Unknowns of Building LCA
- L7: Evaluate Subgrade Construction, Parking and Foundations
- L8: Regional Variation
- G1: Re-Use/Retrofit/New
- G2: National Industry Implications
- G3: Office Building Benchmarks

Question 8.

Explain why you selected this project as your second priority.

Question 9.
Which research project would you identify as your THIRD priority?

- P1: LCA Practice Guide
- P2: LCA Baseline Building Guidance (LEED v4)
- P3: Building Industry LCA Dataset (aligned/open source)
- P4: Define Reference/Benchmark Building
- P5: Lifespan Standardization
- L1: Standardized Building Models
- L2: Housing LCA
- L3: Data/Tool Comparison
- L4: Material Quantity Reporting

- L5: Building Scale/Construction Trends
- L6: Evaluate the Known Unknowns of Building LCA
- L7: Evaluate Subgrade Construction, Parking and Foundations
- L8: Regional Variation
- G1: Re-Use/Retrofit/New
- G2: National Industry Implications
- G3: Office Building Benchmarks

Question 10.

Explain why you selected this project as your third priority.

[<< Previous](#) **[Next >>](#)**

Questions or Comments?
Contact KATHRINA L SIMONEN at ksimonen@u.washington.edu

Embodied Carbon Benchmark Advisory Committee

Question 11.
How would you characterize yourself (pick the category that fits best)

- [ ] LCA Professional
- [ ] Academic/Researcher
- [ ] Design Professional
- [ ] Manufacturer
- [ ] Other:

Question 12.

Please add any other comments you would like to share with the research team. Note you may also send comments/suggestions via email to ksimonen@uw.edu.

THANK YOU!

<< Previous Submit responses

Questions or Comments?
Contact KATHRINA L SIMONEN at ksimonen@u.washington.edu

Statistics for Embodied Carbon Benchmark Advisory Committee

Total submissions: 26

** Calculated using numeric values*

Matrix - one answer per row (button)
Question

Please asses your level of confidence with the following statements acknowledging the limitations noted in the report draft (PAGE 20). Note the third and fourth statement have changed slightly since the December draft/January conference calls.

Row 1

The data presented in the RESEARCH database represents a reasonable order of magnitude and range of variation of estimates of the embodied carbon footprint of buildings.

Total responses (N): 26 Did not respond: 0

Numeric value	*Answer*	*Frequency*	*Percentage*
1	High Confidence	6	23.08%
2	Confident	17	65.38%
3	Neutral	1	3.85%
4	Low Confidence	2	7.69%
5	Disagree	0	0.00%

Row 2

The initial embodied carbon (LCA stage A) of a building's structure, foundation and enclosure is typically less than 1,000 kgCO2e/m2.

Total responses (N): 25 Did not respond: 1

Numeric value	*Answer*	*Frequency*	*Percentage*
1	High Confidence	13	52.00%
2	Confident	9	36.00%
3	Neutral	2	8.00%
4	Low Confidence	1	4.00%
5	Disagree	0	0.00%

Row 3

The initial embodied carbon (LCA stage A) of low-rise (less than 7 story) residential building's structure, foundation and enclosure is typically less than 500 kgCO2e/m2 however there is not sufficient data to state ranges with confidence.

Total responses (N): 26 Did not respond: 0

Numeric value	*Answer*	*Frequency*	*Percentage*
1	High Confidence	4	15.38%
2	Confident	15	57.69%
3	Neutral	7	26.92%
4	Low Confidence	0	0.00%
5	Disagree	0	0.00%

Row 4

For commercial office buildings, the range of initial embodied carbon (LCA stage A) for building structure, foundation and enclosure is between 200 and 500 kg CO2e/m2 for 50% of buildings in the database.

Total responses (N): 26 Did not respond: 0

Numeric value	*Answer*	*Frequency*	*Percentage*
1	High Confidence	7	26.92%
2	Confident	13	50.00%
3	Neutral	4	15.38%

	*Response statistics**
Row1	
Mean	1.96
Median	2.00
Mode	2
Min/Max	1/4
Standard deviation	0.77
Row2	
Mean	1.64
Median	1.00
Mode	1
Min/Max	1/4
Standard deviation	0.81
Row3	
Mean	2.12
Median	2.00
Mode	2
Min/Max	1/3
Standard deviation	0.65
Row4	
Mean	2.12
Median	2.00
Mode	2
Min/Max	1/5
Standard deviation	1.07

4	Low Confidence	0	0.00%
5	Disagree	2	7.69%

Matrix - one answer per row (button)
Question

STANDARDIZING PRACTICE (pg 21)

Row 1

P1: LCA Practice Guide

Total responses (N): 26 Did not respond: 0

Numeric value	*Answer*	*Frequency*	*Percentage*
1	Critical	12	46.15%
2	Essential	12	46.15%
3	Valuable	2	7.69%
4	Neutral	0	0.00%
5	Not Important	0	0.00%

Row 2

P2: LCA Baseline Building Guidance (LEED v4)

Total responses (N): 26 Did not respond: 0

Numeric value	*Answer*	*Frequency*	*Percentage*
1	Critical	4	15.38%
2	Essential	14	53.85%
3	Valuable	8	30.77%
4	Neutral	0	0.00%
5	Not Important	0	0.00%

Row 3

P3: Building Industry Dataset (aligned/open source)

Total responses (N): 25 Did not respond: 1

Numeric value	*Answer*	*Frequency*	*Percentage*
1	Critical	7	28.00%
2	Essential	8	32.00%
3	Valuable	10	40.00%
4	Neutral	0	0.00%
5	Not Important	0	0.00%

Row 4

P4: Define Reference/Benchmark Building

Total responses (N): 26 Did not respond: 0

Numeric value	*Answer*	*Frequency*	*Percentage*
1	Critical	7	26.92%
2	Essential	11	42.31%
3	Valuable	6	23.08%
4	Neutral	2	7.69%
5	Not Important	0	0.00%

Row 5

P5: Lifespan Standardization

Total responses (N): 26 Did not respond: 0

Numeric value	*Answer*	*Frequency*	*Percentage*
1	Critical	1	3.85%
2	Essential	8	30.77%
3	Valuable	14	53.85%

	*Response statistics**
Row1	
Mean	1.62
Median	2.00
Mode	1, 2
Min/Max	1/3
Standard deviation	0.64
Row2	
Mean	2.15
Median	2.00
Mode	2
Min/Max	1/3
Standard deviation	0.67
Row3	
Mean	2.12
Median	2.00
Mode	3
Min/Max	1/3
Standard deviation	0.83
Row4	
Mean	2.12
Median	2.00
Mode	2
Min/Max	1/4
Standard deviation	0.91
Row5	
Mean	2.73
Median	3.00
Mode	3
Min/Max	1/4
Standard deviation	0.72

4	Neutral	3	11.54%
5	Not Important	0	0.00%

Matrix - one answer per row (button)
Question

GENERATING LCA DATA (page 22)

Row 1

L1: Standardized Building Models

Total responses (N): 26 Did not respond: 0

Numeric value	*Answer*	*Frequency*	*Percentage*
1	Critical	7	26.92%
2	Essential	8	30.77%
3	Valuable	8	30.77%
4	Neutral	3	11.54%
5	Not Important	0	0.00%

Row 2

L2: Housing LCA

Total responses (N): 26 Did not respond: 0

Numeric value	*Answer*	*Frequency*	*Percentage*
1	Critical	2	7.69%
2	Essential	5	19.23%
3	Valuable	16	61.54%
4	Neutral	3	11.54%
5	Not Important	0	0.00%

Row 3

L3: Data/Tool Comparison

Total responses (N): 25 Did not respond: 1

Numeric value	*Answer*	*Frequency*	*Percentage*
1	Critical	2	8.00%
2	Essential	11	44.00%
3	Valuable	12	48.00%
4	Neutral	0	0.00%
5	Not Important	0	0.00%

Row 4

L4: Material Quantity Reporting

Total responses (N): 26 Did not respond: 0

Numeric value	*Answer*	*Frequency*	*Percentage*
1	Critical	10	38.46%
2	Essential	11	42.31%
3	Valuable	5	19.23%
4	Neutral	0	0.00%
5	Not Important	0	0.00%

Row 5

L5: Building Scale/Construction Trends

Total responses (N): 25 Did not respond: 1

Numeric value	*Answer*	*Frequency*	*Percentage*
1	Critical	1	4.00%
2	Essential	5	20.00%
3	Valuable	14	56.00%

	*Response statistics**
Row1	
Mean	2.27
Median	2.00
Mode	2, 3
Min/Max	1/4
Standard deviation	1.00
Row2	
Mean	2.77
Median	3.00
Mode	3
Min/Max	1/4
Standard deviation	0.76
Row3	
Mean	2.40
Median	2.00
Mode	3
Min/Max	1/3
Standard deviation	0.65
Row4	
Mean	1.81
Median	2.00
Mode	2
Min/Max	1/3
Standard deviation	0.75
Row5	
Mean	2.92
Median	3.00
Mode	3
Min/Max	1/4
Standard deviation	0.76
Row6	
Mean	2.48
Median	3.00
Mode	3
Min/Max	1/4
Standard deviation	0.87
Row7	
Mean	2.85
Median	3.00
Mode	3
Min/Max	1/4
Standard deviation	0.73
Row8	
Mean	2.65
Median	3.00
Mode	3
Min/Max	1/4
Standard deviation	0.85

4	Neutral	5	20.00%
5	Not Important	0	0.00%

Row 6

L6: Evaluating the Known Unknowns of Building LCA

Total responses (N): 25 Did not respond: 1

Numeric value	*Answer*	*Frequency*	*Percentage*
1	Critical	4	16.00%
2	Essential	7	28.00%
3	Valuable	12	48.00%
4	Neutral	2	8.00%
5	Not Important	0	0.00%

Row 7

L7: Evaluating Subgrade Construction, Parking and Foundations

Total responses (N): 26 Did not respond: 0

Numeric value	*Answer*	*Frequency*	*Percentage*
1	Critical	1	3.85%
2	Essential	6	23.08%
3	Valuable	15	57.69%
4	Neutral	4	15.38%
5	Not Important	0	0.00%

Row 8

L8: Regional Variation

Total responses (N): 26 Did not respond: 0

Numeric value	*Answer*	*Frequency*	*Percentage*
1	Critical	3	11.54%
2	Essential	6	23.08%
3	Valuable	14	53.85%
4	Neutral	3	11.54%
5	Not Important	0	0.00%

Matrix - one answer per row (button)
Question

DEVELOPING GUIDANCE (page 23)

Row 1

G1: Re-use/Retrofit/New

Total responses (N): 26 Did not respond: 0

Numeric value	*Answer*	*Frequency*	*Percentage*
1	Critical	2	7.69%
2	Essential	12	46.15%
3	Valuable	12	46.15%
4	Neutral	0	0.00%
5	Not Important	0	0.00%

Row 2

G2: National Industry Implications

Total responses (N): 26 Did not respond: 0

Numeric value	*Answer*	*Frequency*	*Percentage*
1	Critical	4	15.38%
2	Essential	13	50.00%
3		6	23.08%

	*Response statistics**
Row1	
Mean	2.38
Median	2.00
Mode	2, 3
Min/Max	1/3
Standard deviation	0.64
Row2	
Mean	2.31
Median	2.00
Mode	2
Min/Max	1/4
Standard deviation	0.88
Row3	
Mean	2.19
Median	2.00
Mode	2
Min/Max	1/4
Standard deviation	0.80

	Valuable		
4	Neutral	3	11.54%
5	Not Important	0	0.00%

Row 3

G3: Office Building Benchmarks

Total responses (N): 26 Did not respond: 0

Numeric value	*Answer*	*Frequency*	*Percentage*
1	Critical	5	19.23%
2	Essential	12	46.15%
3	Valuable	8	30.77%
4	Neutral	1	3.85%
5	Not Important	0	0.00%

Multiple choice - one answer (button)
Question

Which research project would you identify as your FIRST priority?

Total responses (N): 26 Did not respond: 0

Numeric value	*Answer*	*Frequency*	*Percentage*
1	P1: LCA Practice Guide	9	34.62%
2	P2: LCA Baseline Building Guidance (LEED v4)	0	0.00%
3	P3: Building Industry LCA Dataset (aligned/open source)	6	23.08%
4	P4: Define Reference/Benchmark Building	4	15.38%
5	P5: Lifespan Standardization	0	0.00%
6	L1: Standardized Building Models	0	0.00%
7	L2: Housing LCA	0	0.00%
8	L3: Data/Tool Comparison	0	0.00%
9	L4: Material Quantity Reporting	3	11.54%
10	L5: Building Scale/Construction Trends	1	3.85%
11	L6: Evaluate the Known Unknowns of Building LCA	0	0.00%
12	L7: Evaluate Subgrade Construction, Parking and Foundations	0	0.00%
13	L8: Regional Variation	0	0.00%
14	G1: Re-Use/Retrofit/New	2	7.69%
15	G2: National Industry Implications	0	0.00%
16	G3: Office Building Benchmarks	1	3.85%

	*Response statistics**
Mean	4.77
Median	9.50
Mode	1
Min/Max	1/16
Standard deviation	4.59

Long response
Question

Explain why you selected this project as your first priority.

Total responses (N): 25 Did not respond: 1

Statistics are not calculated for this question type.

Multiple choice - one answer (button)
Question

Which research project would you identify as your SECOND priority?

Total responses (N): 26 Did not respond: 0

Numeric value	*Answer*	*Frequency*	*Percentage*
1	P1: LCA Practice Guide	7	26.92%
2	P2: LCA Baseline Building Guidance (LEED v4)	5	19.23%
3	P3: Building Industry LCA Dataset (aligned/open source)	3	11.54%
4	P4: Define Reference/Benchmark Building	6	23.08%
5	P5: Lifespan Standardization	0	0.00%
6	L1: Standardized Building Models	1	3.85%
7	L2: Housing LCA	0	0.00%
8	L3: Data/Tool Comparison	1	3.85%
9	L4: Material Quantity Reporting	2	7.69%
10	L5: Building Scale/Construction Trends	0	0.00%
11	L6: Evaluate the Known Unknowns of Building LCA	0	0.00%
12	L7: Evaluate Subgrade Construction, Parking and Foundations	0	0.00%
13	L8: Regional Variation	0	0.00%
14	G1: Re-Use/Retrofit/New	0	0.00%
15	G2: National Industry Implications	1	3.85%
16	G3: Office Building Benchmarks	0	0.00%

	*Response statistics**
Mean	3.73
Median	2.50
Mode	1
Min/Max	1/15
Standard deviation	3.32

Long response
Question

Explain why you selected this project as your second priority.

Total responses (N): 25 Did not respond: 1

Statistics are not calculated for this question type.

Multiple choice - one answer (button)
Question

Which research project would you identify as your THIRD priority?

Total responses (N): 26 Did not respond: 0

Numeric value	*Answer*	*Frequency*	*Percentage*
1	P1: LCA Practice Guide	3	11.54%
2	P2: LCA Baseline Building Guidance (LEED v4)	5	19.23%
3	P3: Building Industry LCA Dataset (aligned/open source)	4	15.38%

	*Response statistics**
Mean	5.58
Median	3.00
Mode	2
Min/Max	1/16
Standard deviation	4.35

4	P4: Define Reference/Benchmark Building	3	11.54%
5	P5: Lifespan Standardization	0	0.00%
6	L1: Standardized Building Models	2	7.69%
7	L2: Housing LCA	1	3.85%
8	L3: Data/Tool Comparison	1	3.85%
9	L4: Material Quantity Reporting	3	11.54%
10	L5: Building Scale/Construction Trends	0	0.00%
11	L6: Evaluate the Known Unknowns of Building LCA	1	3.85%
12	L7: Evaluate Subgrade Construction, Parking and Foundations	1	3.85%
13	L8: Regional Variation	0	0.00%
14	G1: Re-Use/Retrofit/New	0	0.00%
15	G2: National Industry Implications	1	3.85%
16	G3: Office Building Benchmarks	1	3.85%

Long response
Question

Explain why you selected this project as your third priority.

Total responses (N): 25 Did not respond: 1

Statistics are not calculated for this question type.

Multiple choice - multiple answers (check)
Question

How would you characterize yourself (pick the category that fits best)

Total responses (N): 24 Did not respond: 0

Numeric value	*Answer*	*Frequency*	*Percentage*
1	LCA Professional	4	16.67%
2	Academic/Researcher	6	25.00%
3	Design Professional	8	33.33%
4	Manufacturer	0	0.00%
5	Other:	7	29.17%

	*Response statistics**
Mean	3.00
Median	3.00
Mode	3
Min/Max	1/5
Standard deviation	1.44

Multiple choice - multiple answers (check)
Question

How would you characterize yourself (pick the category that fits best)

Total responses (N): 2 Did not respond: 0

Numeric value	*Answer*	*Frequency*	*Percentage*
1	LCA Professional	1	50.00%
2	Academic/Researcher	2	100.00%
3	Design Professional	1	50.00%
4	Manufacturer	0	0.00%

	*Response statistics**
Mean	2.00
Median	2.00
Mode	2
Min/Max	1/3
Standard deviation	0.82

Long response
Question

Please add any other comments you would like to share with the research team. Note you may also send comments/suggestions via email to ksimonen@uw.edu.

Total responses (N): 16 Did not respond: 10

Statistics are not calculated for this question type.

SURVEY WRITTEN RESPONSES

The following is a transcript of the written comments to the survey to answer 'Why' each of these projects was selected as one of the top three projects to enable 'your LCA practice and/or your use of LCA data in Practice'.

P1: LCA Practice Guide

1. We have collected a large dataset of material quantities (L4) and have run our own internal LCA studies against these. To make this more valuable and to understand our position in the industry we need to be able to compare against other practice data. Therefore I think it now important that we define a standardized LCA Practice Guide. I think this guide should incorporate some of the other elements in this list such as L1, L3, L8.
2. To do LCA designers must have a guide to the practice (how to do it).
3. Methods must absolutely be standardized before moving forward and generating new data.
4. "LCA credibility is lacking because the process and underlying data, are not yet consistent or reliable. The LCA Practice Guide is a step in the direction of bringing clarity to this.
5. How should LCA be used to inform design? To inform the procurement process of construction? To compare embodied and operational carbon footprints with time?
6. It would be good to see more alignment with progress happening within Europe, especially around attempts to achieve consistent and comparable material data sets. "
7. LCA methodology varies widely based on interpretation and LCI source. If the building scope and LCI data could be made more consistent, then one could be confident that the buildings were "measured" the same way.
8. Enabling scaling up of LCA use.
9. Important infrastructure to standardize WB-LCA, harmonized with benchmarks
10. This feels like a key early step on which much of the other work (Standardized Building Models, National Industry Implications, Building Scale/Construction Trends, Office Buildings Benchmarks, etc.) would rely. I think that the Building Industry LCA Dataset is important, but less likely to affect order-of-magnitude results than some of the other measures.
11. Let's get people educated!
12. "We can't write policy fostering lower carbon building if the design & building community doesn't have a SIMPLIFIED tool by which to assess & report a particular project footprint.

13. Yes, I know: LCA is anything but simple. But same is true of a basic energy analysis of even a simple detached house, yet California boiled it down to where anyone can hire a third party to conduct a standardized review (aka ""Title 24"") -- and that is making a huge difference."
14. To date, the whole-building LCA field has been characterized by a lack of cohesion in terms of methods, scopes, building lifespans, and included building assemblies. This makes comparison of results nearly impossible and reduces the value of the data. Progress in this field depends on developing a rigorous and consistent approach, similar to the development arc of energy codes and then building energy modeling.
15. To collect good data an LCA practice Guide would be very helpful. (P1)
16. "A problem well stated is a problem half solved". I think we need more data, case studies, industry expertise in order to calculate the performance indicators properly so results are comparable. Once we understand the problem in more details it will be easier to understand where biggest impacts are coming from and also solve performance gaps for data analysis.
17. Drawing statistically valid conclusions from data that has been collected using different methodologies and analytical techniques is very challenging and you need an enormous data set. Establishing an agreed upon methodology for the building industry would be of tremendous value and would be a significant step along the way towards establishing industry averages and norms.
18. LCA practitioners require consistent data, a practice guide contributes directly towards this effort
19. In order to compare results, to build reference value, modelization must be homogenized

P2: LCA Baseline Building Guidance (LEED V4)

1. With V4 now being mandatory, the market, and USGBC needs guidance on how to credibly define a baseline (this may be multiple options), otherwise folks will be more likely to make mis-informed comparisons. Also having a document to cite will help to reign in just anyone putting data into an LCA tool.
2. Again, folks are using this and generating their own baseline building -- they know enough to be dangerous with LCA.
3. This definition and credit amendment can help fuel P1 and L4 and should be given a high industry importance.
4. Given a large number of projects that do WBLCA are incentivized by LEEDv4 I think it important to level the playing field for these early adopters

and make sure the data we get from these first studies will be useful and defensible. I think the LCA Practice Guide is equally important but could be "for LEEDv4" in name to attract more readers/users.

5. It needs to be better, and more easily, defined to ensure consistency.
6. Incentivize industry to participate to data collection and decrease of embodied carbon in buildings.
7. How you define your baseline building is directly resulted to any claims you can make in terms of embodied carbon reduction. Is the baseline building an identical building that uses the same materials except with no consideration given to selection of low CO2e products? is it a completely different building, designed using a typical approach for that typology in that region (100% concrete construction in Florida; steel composite in NY for example). So how we define our baseline building directly affects what we can say about our proposed building and probably leads to a design direction for improvement.
8. without reference building its impossible to show improvements, which is core to sustainable development
9. Works like a lever of action to promote the lca approach

P3: Building Industry Dataset (aligned/open source)

1. A robust LCA dataset would allow prioritization of subsequent efforts.
2. If we had an aligned data we could tackle most the rest with confidence. (P3) This one probably can't happen first. Housing is important because nobody is collecting this data and it makes up 3/4 of what we build, but it is the easiest one to model (L2) - single family housing is pretty uniform and everything depends on accurate, standardized material quantity reporting. (L4)"
3. Material level: As a practicing structural engineer, I need to have accurate numbers at hand to assist in advising clients and/or making material choices
4. Whole building level: As part of local building governance, I'd like to be able to incentivize low-carbon building be setting targets geared to location & building type."
5. I would actually place P1 and P3 together in my mind. The two tasks can be done, to some degree in tandem and the quality of each would greatly be improved by approaching this task as somewhat of an iterative process. The research team will have a very hard time creating an informed Practice Guide without greater familiarity with LCA data and an understanding of the trade-offs implicit in the methodology decisions without being able to test these hypotheses using data. All too often, LCA Practice Guidance is being pursued in an unscientific manner in the absence of such data -- diminishing the ability for technical guidance to drive the development of LCA tools and data available.

The task of beginning to compile, structure, align and critique LCA models is essential to this pursuit.

6. A focused effort on a common LCA data source would make all other efforts considerable more meaningful.
7. Does P1 by necessity have to come before P3? Maybe it's a moot point since the work for P1 is already funded so will likely come first regardless. Either way I think the sooner we can have an aligned, comprehensive, and open-source database the better.
8. The ability to connect it to the larger scheme of things is important.
9. Research on datasets will drive innovation and create better competition I believe. The more informed decision we can make the better for the whole industry and the planet. A standardized and fair process of comparing different construction methods and materials is essential to build LCA knowhow within the industry. A good example is France where you can only promote the "green credentials" of your product if you have done an LCA. Using EN15804 for example can drive aligned data globally.
10. To ask a property owner to invest time and potentially money in adopting measures to reduce life cycle carbon of a building, the developer typically needs some sort of incentive. In our experience that incentive may be a simple statement that can be made in marketing materials that show some sort of differentiation of his products over that of a competitor. SO saying 'my building has xx% less carbon than that of a typical building because of measures that we invested in that show our commitment to the environment bla bla bla' would be such a statement. The problem here is that we don't have as standard regional database for CO2e of materials and the tools that do exist are difficult for us to be able to enter new LCA data for our specified products into. This means that it is challenging to develop a defensible baseline building and therefore difficult to estimate defensible reduction in CO2e for our projects. P1 and P2 would also be high priority.
11. Without a common database, results are not comparable at the building scale due to the variability at the product scale.
12. To help drive down the uncertainty of the LCI data and impact assessment methods.

P4: Define Reference/Benchmark Building

1. Defining benchmarks for buildings informs standardizing WB-LCA practice
2. Until a consistent and rigorous approach to developing a reference building is established, designers using whole building LCA analysis to meet green building requirements or credits will continue to game the system - creating reference buildings that make their design case look favorable in comparison. The result is an ineffective credit or requirement that cannot fulfill its purpose - ie, encouraging real savings and design changes to minimize embodied carbon.

Carbon/sf values could provide a path around the reference building approach and associated issues, but it will take more time to develop appropriate carbon/sf values for a a range of building types, sizes, energy performance levels, and climate/construction regions. And doing this work may require development of reference buildings in the first place.

3. Having a benchmark will enable the consumer to make educated decisions on the rating of their system scheme.
4. Once all are modelling to the same practice then we can start to compare back to an industry recognized benchmark building.
5. People who are not doing LEEDv4, or who are in early design, need something to compare their designs to without having to create a baseline.
6. The point of gathering the data was to be able to set a benchmark to encourage the construction of lower-carbon buildings. Hopefully, establishing this benchmark will act as "motivation" for the building industry to track and minimize their carbon.
7. LCA Baseline Building Guidance (LEED v4) will give an incentive to report material quantities and embodied carbon, but a necessary first step is to define a reference / benchmark building
8. We need something to compare to, just like any other code or standard.
9. Building consensus around benchmark buildings will be a very challenging task. However, I believe that it is essential to support the actual practice of LCA in design. Asking architects to fully design and model benchmark buildings on a project specific basis is a significant barrier to the adoption of LCA in practice and greatly limits the ability for architects and engineers to evaluate their model results.
10. After we calculate, we should be able to compare. Setting a well defined benchmark helps the industry to understand how far we are from solving the climate change issue related to buildings. It will help identify opportunity for improvements in legislation and supply chain for example, according to business as usual practices.
11. without reference building its impossible to show improvements, which is core to sustainable development
12. LCA knowledge requires a statistically significant building.
13. The exercise of surveying the design team to develop a reference design is typically not welcome on building design project teams. This is one more task for the LCA consultant to coordinate on a building LCA project, where the team is laser focused on creating the right building rather than spending billable hours imagining a hypothetical building.

L1: Standardized Building Models

1. Development of reference buildings (and guidelines for creating them) must progress side-by-side with confirmation of real-world LCA results. These two

research efforts support each other and can be used for confirmation and cross checks.

2. "Like energy performance modeling within LEED, if we can outline how to define a prescriptively designed ""baseline"" building that is unique to each project and site, and then for designers to provide alternatives to that baseline building that shows % carbon footprint reductions, meaningful actions may come from LCA efforts during design processes.
3. It is important to help define how this can happen.
4. Industry averaged buildings will be noteworthy for understanding starting points, but the data scatter will be too large for it to be overly meaningful. Better will be to define a process by which a project specific baselines can be established.

L2: Housing LCA

1. Again I was choosing between two, either L2 or L4. L4 is already under way though, and since it is my understanding that the majority of existing buildings, and likely new construction, will be residential, I think the more information we can publish about the relative impacts of each type/design methodology the better.

L3: Data/Tool Comparison

1. Material data is not yet reliable. It needs to start with credible/comparable industry average material carbon footprint data, with COMPARABLE boundary conditions.
2. From that, project specific material choices need to be measured against the industry average datasets for showing carbon footprint impacts. This is how LCA will best help achieve informed decision making processes.
3. ...timber and steel industries especially need to be tackled to get to credible reporting on the above."
4. This might help with P1: Practice Guide. Understanding the differences between LCI sources would answer the question of which LCI sources are most conservative or preferred to use in the practice guide, or to develop correction factors to better standardize LCA's done with different sources.

L4: Material Quantity Reporting

1. Material quantities are the basis of the LCA. Without accurate quantity reporting all the other efforts would be considerably less useful. My experience in comparing whole building LCAs is that material quantities is typically the leading factor driving differences in results.
2. I think we need to get everyone reporting quantities the same way and then the LCI factors can be interchanged to reduce the noise currently in the results of various WBLCA studies.

3. These are quantities that we are most certain of. Once the field of LCA has matured, material quantity reporting will enable detailed and accurate comparisons.
4. Material quantities allow LCA results to be de-coupled from specific software and LCIs.
5. If we can get materials reported consistently it should be possible to re-run LCA studies as assumptions and data evolve.
6. An entry for the use of LCA results to inform building design is to be bring it in during design alongside cost estimation practices.
   Cost estimation already requires building geometry and material quantities to be estimated. In my experience, the format of these estimations from organization to organization can differ substantially (many don't estimate material quantities of the final design), and the timing of acquiring and organizing the material quantities is typically too long to make the study useful to design decision making.

L5: Building Scale/Construction Trends

1. The ability to compare a future project to existing data is important. Recommendations are easy to pay attention to.

L6: Evaluating the Known Unknowns of Building LCA

1. Evaluation of the known unknowns of LCA would allow decisions based on LCA to be better contextualized.

L7: Evaluating Subgrade Construction, Parking and Foundations

1. If we aren't evaluating subgrade / foundations we are missing a big chunk of pie.