24TH AVA CONGRESS
BALI - INDONESIA
22-24 NOVEMBER 2022

Building Sector:
energy efficiency and valuation challenges

AGENDA

1. A research: energy efficiency profile of Indonesian Public Buildings

1. Valuation and green buildings market

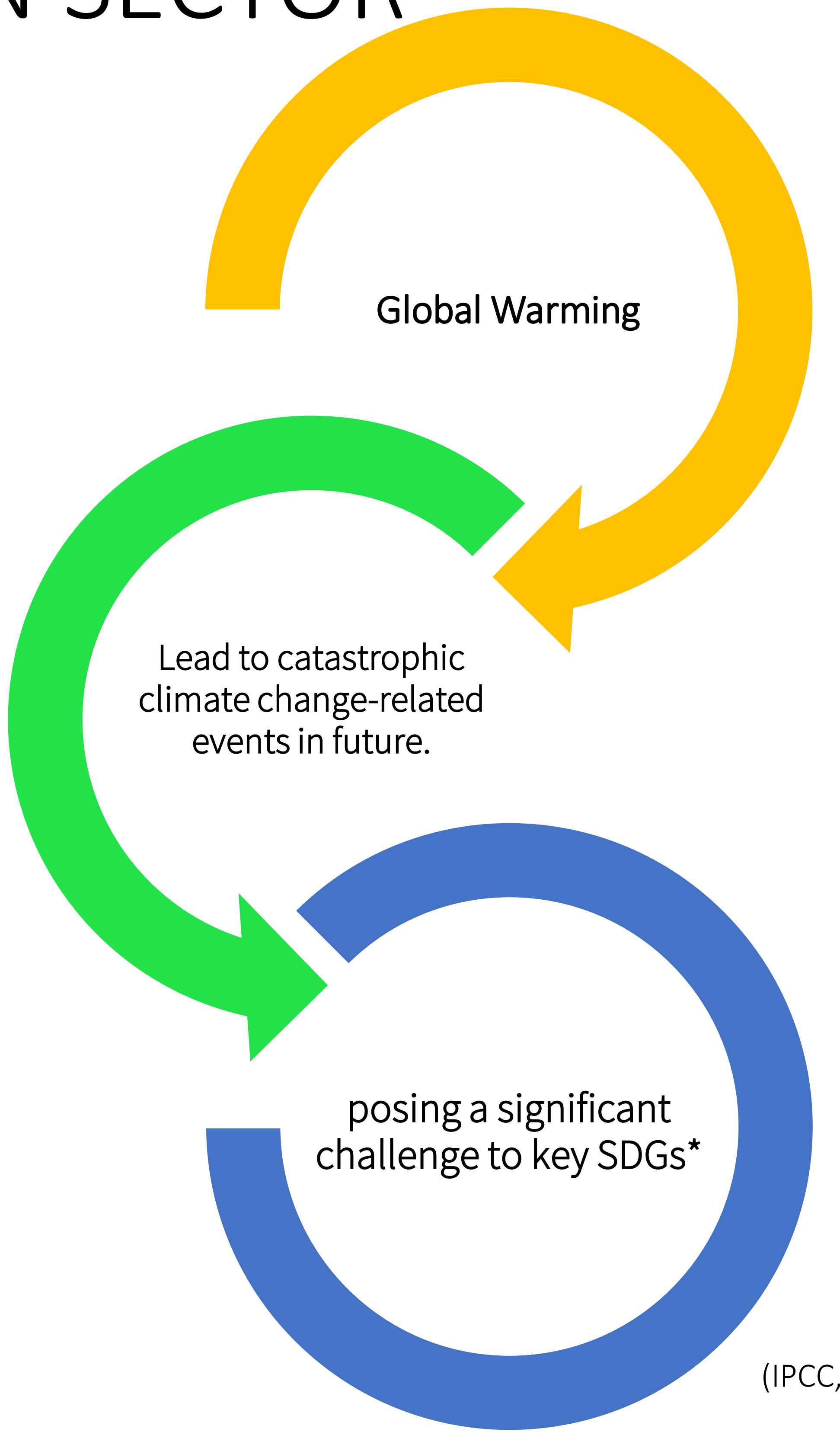
ENERGY USE IN BUILDINGS AND CONSTRUCTION SECTOR

Buildings and construction sector accounted for 36% of final energy use and 39% GHG* emissions.

The energy use increased by 7% from 2010 to 2018.

The expansions of building floor area and population are key drivers of the energy consumption.

(International Energy Agency, 2019)



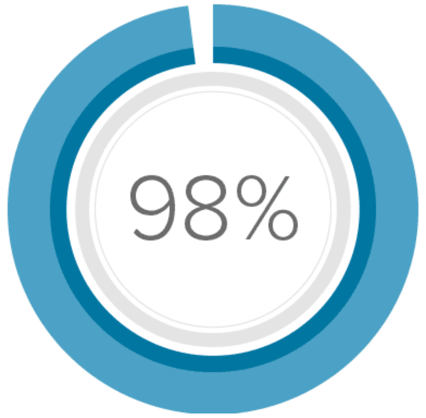
(IPCC, 2018)

*SDGs: Sustainable Development Goals
*GHG: Greenhouse Gas

Strategy for Sustainable Buildings

1 Demolish old buildings then rebuild or New construction

2 Building Adaptation



Rate of Building Adaptation

1% - 2% /year

(International Energy Agency, 2019)

Building Adaptation is all forms of work to enhance the sustainability performance of existing buildings except for minor day-to-day repair and maintenance programs

Image Sources: https://pngio.com/PNG/3801-under-construction-building-png.html

Government Leadership in Developed Countries

Government Leadership

by showcasing public building adaptation projects

(Iwan and Poon, 2008)

PBA in USA :
reduced energy use by 23%

PBA in UK:
Reduce 11% energy consumption

Early Progress of PBA in Tropical Developing Countries

Nigeria :

- Limited commitment and policies on Sustainable Buildings
- Lack of information on building energy use
- (Oyefusi and Adeyemo, 2019; Ochedi and Taki, 2020)

Indonesia:

- Limited data for building energy efficiency
- Limited building energy use disclosure data

(Nasip and Sudarmaji, 2018; Bramono et al. 2019)

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Forecasting of Buildings Stock and Population

Dean et al, 2016

Regions	2015	2030	2050	Growth
	in billion m^2			in %
North America	38.1	47.1	56.9	49.3
Western Europe	29.8	34.3	36.9	23.8
Australia and New Zealand	2.1	2.7	3.4	61.9
Latin America	19.3	29.1	43.1	123
Southeast Asia	15.6	23.8	32.3	107

Edelman et al, 2014

By 2050, some 50 % of the world's population and close to 60% of the world's children are expected to reside in tropical regions.

Research Objectives

1. To understand the profile of energy use of Indonesian public building.

2. To identify factors of Indonesian public building energy consumption.

3. To evaluate Indonesian public buildings adaptation projects

Research Case Study : **Indonesia**

1. The most populated country in the tropical region.
2. The highest GHG emitter among tropical developing countries.
3. The highest electricity demand for air conditioning among tropical developing countries.

(OECD, 2020;UCSUSA, 2020; JRAIA, 2019)

Research Methodology

Quantitative Method

Data Collection Method: Quantitative Secondary Data and Case Study

Analysis : Trend and Crosstabulation, Regression, and Gap Analysis

Data Processing

Source of Data (54,572 Buildings)

1. National Budget Realization
2. State Asset Information Management
3. Tropical Climate Classification
4. State Electricity Company

Unstructured
Insufficient data
Not connected

ked and Cleaned

Final Data (3,507 Buildings)

No	Data Variables
1	Unit Code
2	Unit Name
3	Storey
4	Floor Area
7	Electricity Cost
9	Tropical Climate Classification
10	City
11	Province
12	Building Age
13	Energy Consumption (kWh/m^2)

1. Gross Regional Product (Cities)
2. Project of Public Building Adaptation

CASE STUDY

Building Case Study Selection

Cities Selection

Significant Public Building Energy Consumption Cost → Significant size of economy → Represents tropical climate class

Significant Public Building Energy Consumption Cost

No	Cities Name	Energy Cost (IDR)
1	Jakarta	649,738,411,752
2	Bandung	30,037,367,434
3	Surabaya	29,975,928,983
4	Semarang	23,638,932,654
5	Makassar	23,266,169,155
6	Medan	22,771,550,625

Significant size of economy

No	Cities Name	Gross Regional Product 2019 (Billion IDR)
1	Jakarta	1,742,085
2	Surabaya	544,594
3	Medan	222,482
4	Semarang	131,137
5	Bandung	113,185
6	Makassar	112,568

Represents tropical climate class

No	Climate Type	Cities
1	Tropical Rainforest	Jakarta, Medan, and Bandung
2	Tropical Monsoon	Semarang and Makassar
3	Tropical Savanna	Surabaya

Conventional Buildings Selection

1. The highest energy use;
2. A single office building;
3. High-rise or Low-rise building (Comparable to Adapted Public Buildings);
4. More than five years old.

Case Study Selection…continued

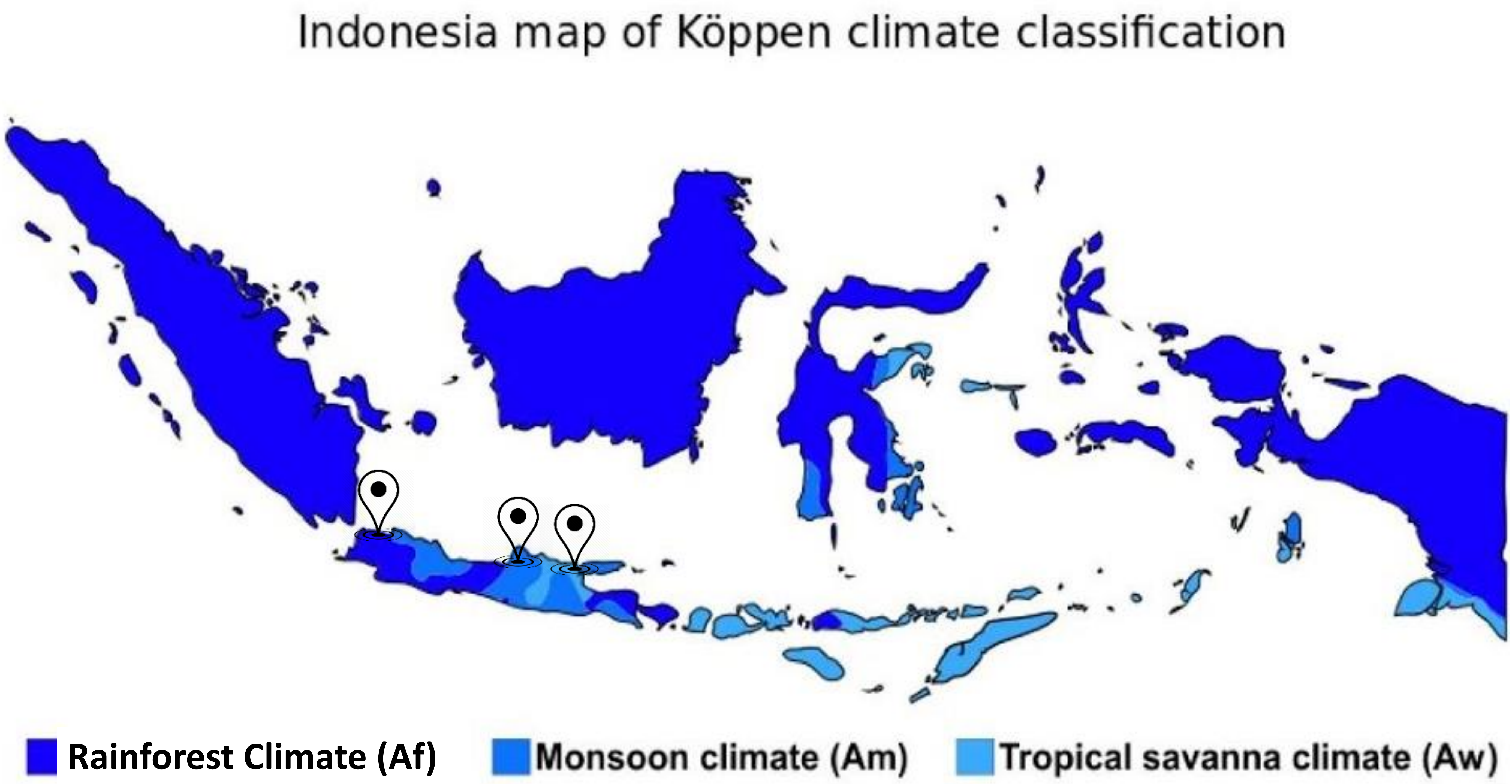


Image from Tito Faradhimu Toni (slideplayer.com)

Selected Cities

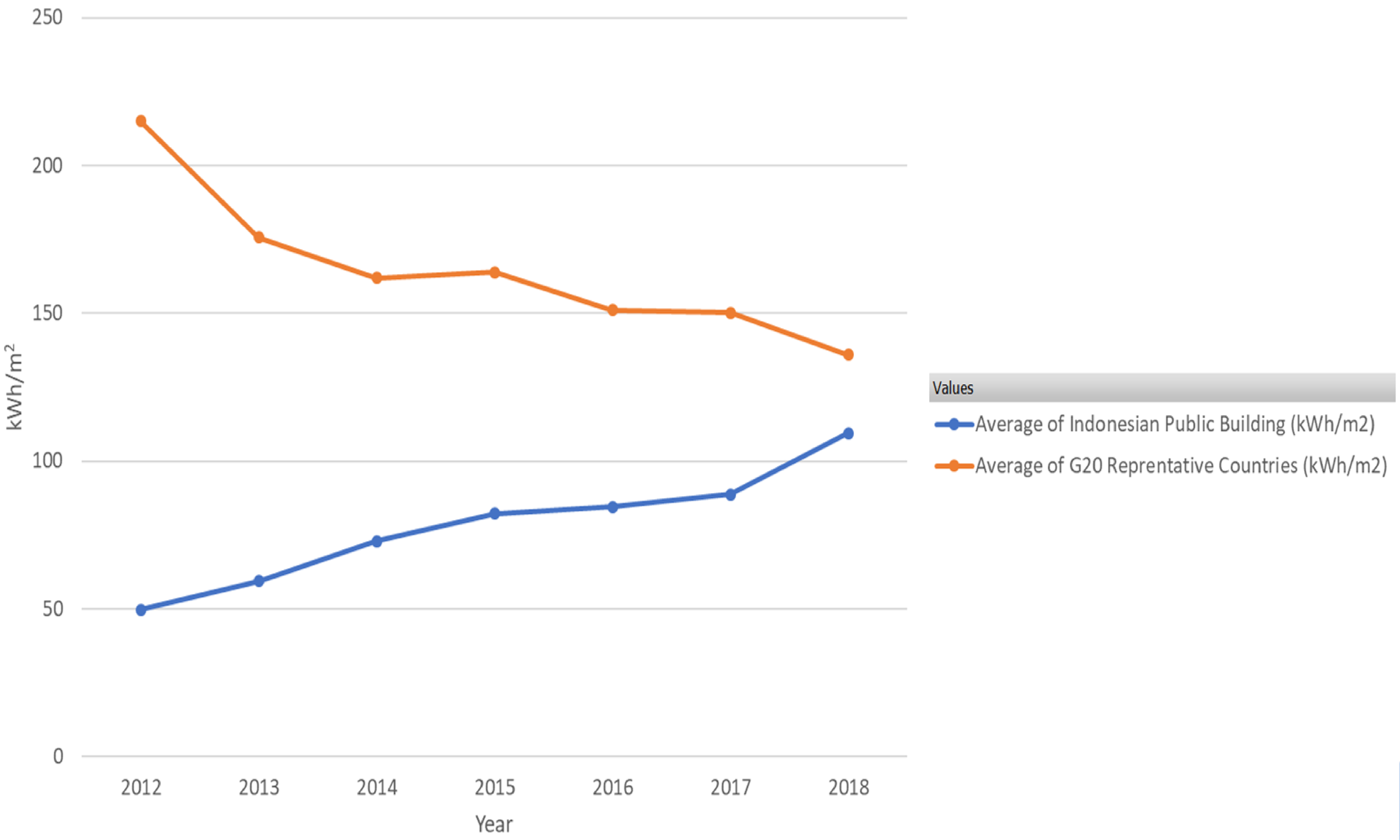
Jakarta, **Semarang**, and **Surabaya**

Research objective 1

To understand the profile of energy use of Indonesian public building.

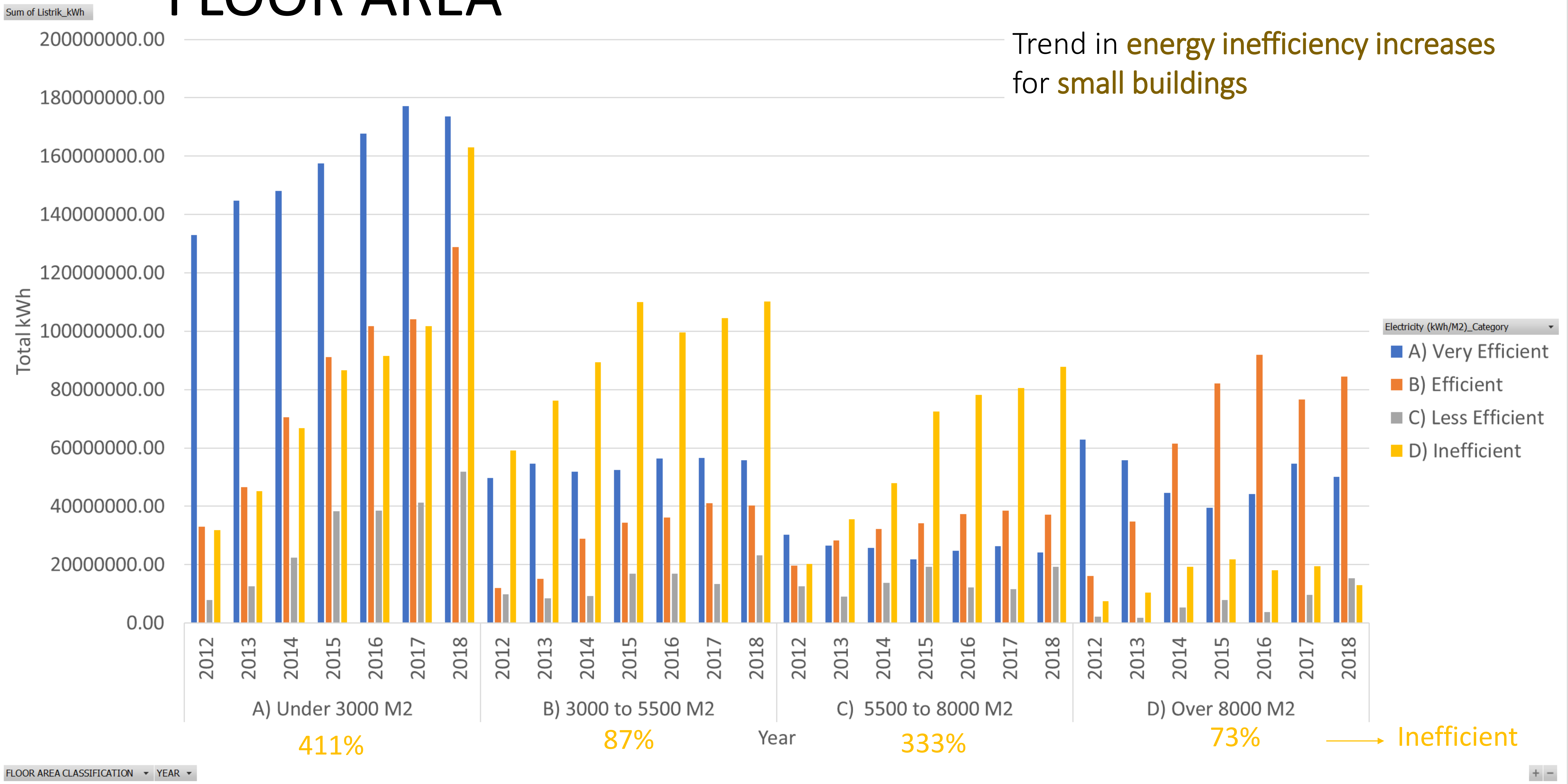
Indonesian Public Building Energy Consumption Trend

Finding :
Indonesian public buildings energy use have steadily increased. G20 countries energy use have continuously decreased during the period.



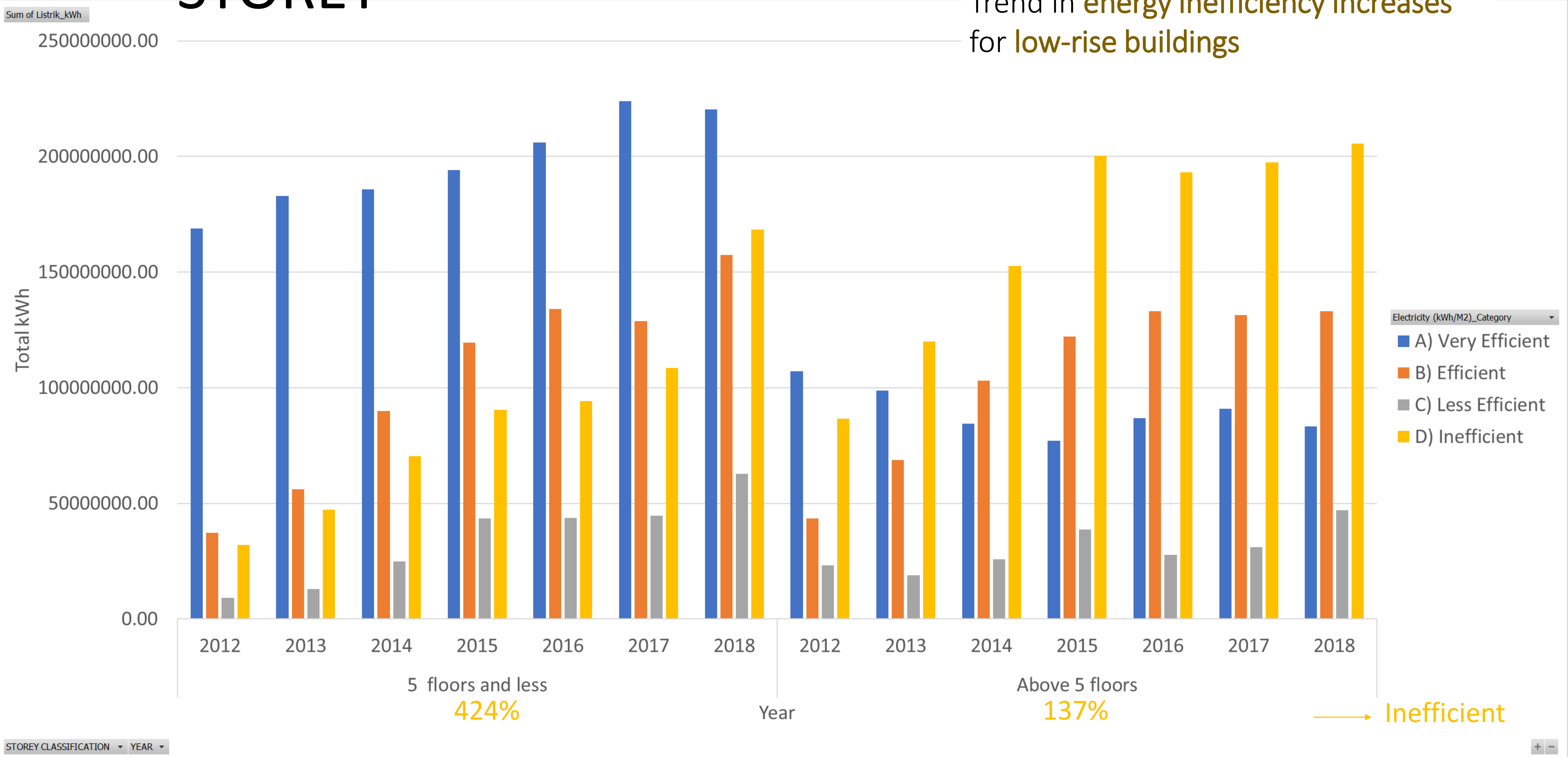
FLOOR AREA

Trend in energy inefficiency increases for small buildings



STOREY

Trend in energy inefficiency increases for low-rise buildings



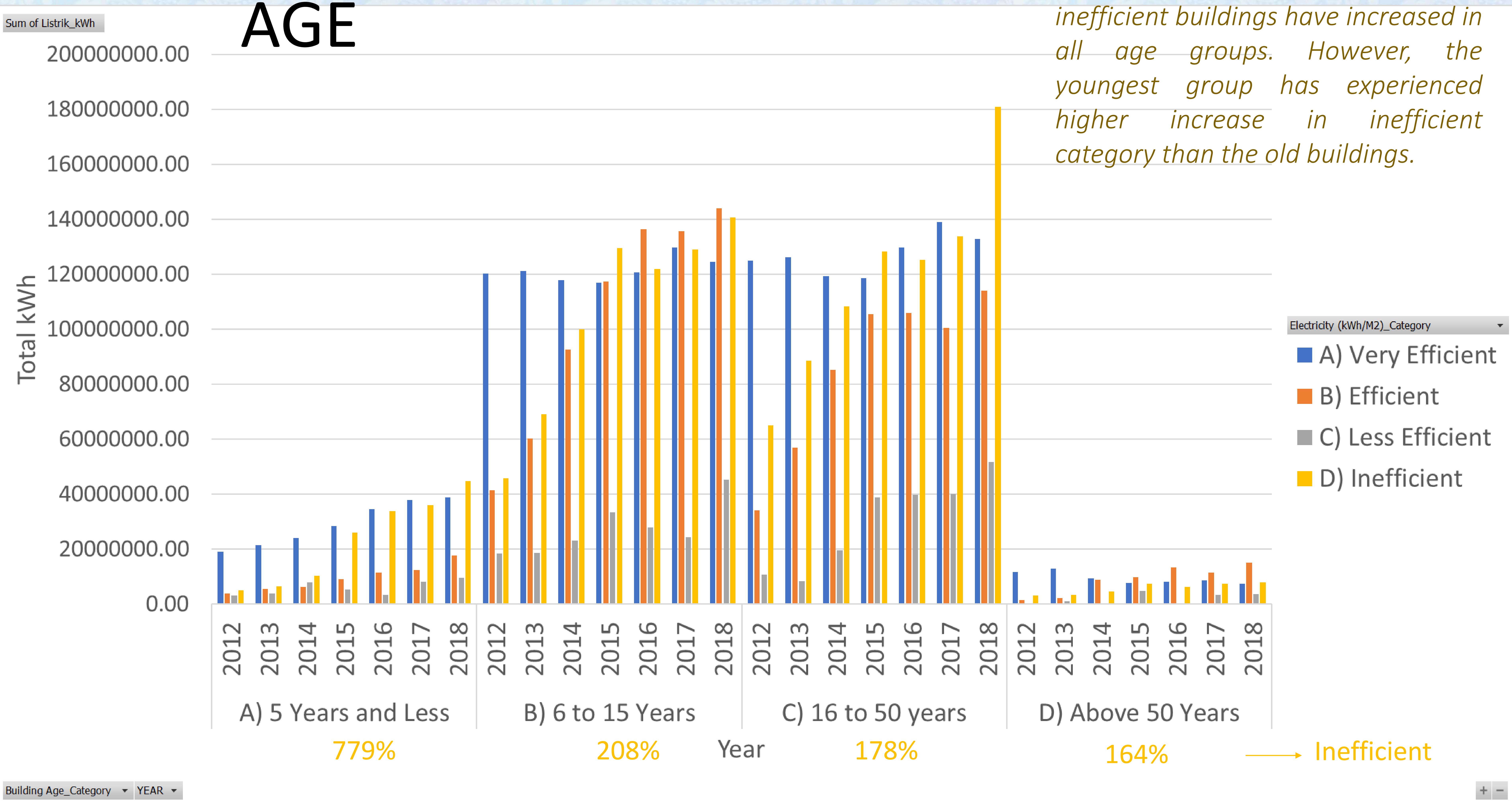
424%

137%

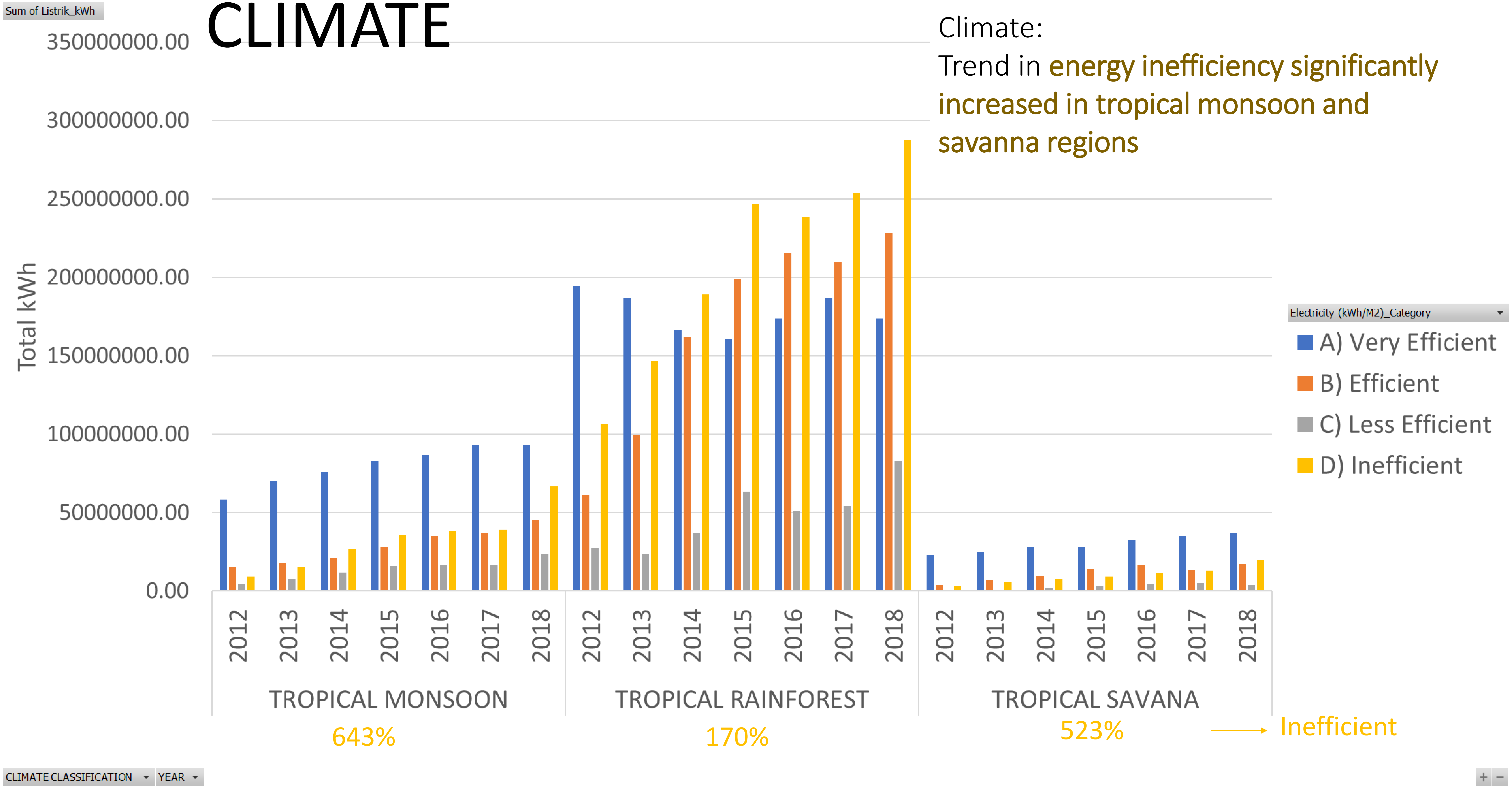
Inefficient

AGE

inefficient buildings have increased in all age groups. However, the youngest group has experienced higher increase in inefficient category than the old buildings.



CLIMATE



Climate:
Trend in energy inefficiency significantly increased in tropical monsoon and savanna regions

643% 170% 523% → Inefficient

Indonesian Public Building Energy Efficiency

Analysis by Floor Area, Storey, Age, and Tropical Climate Classification

Finding:

The inefficiency trend in energy use in Indonesian public buildings are dominated by **small and low buildings**, buildings age **less than five years old**, and buildings in **tropical monsoon region**.

Research objective 2

To identify factors of Indonesian public building energy consumption.

Multicollinearity

		Y	X1	X2	X3	X4	D51	D52
Pearson Correlation	Y	1.000	.707	.501	-.010	.017	-.066	-.056
	X1	.707	1.000	.648	-.035	.021	-.067	-.042
	X2	.501	.648	1.000	-.039	.052	-.099	-.048
	X3	-.010	-.035	-.039	1.000	-.032	.036	.027
	X4	.017	.021	.052	-.032	1.000	-.055	-.025
	D51	-.066	-.067	-.099	.036	-.055	1.000	-.230
	D52	-.056	-.042	-.048	.027	-.025	-.230	1.000

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	10016273.695	25914889.648		.387	.699		
	X1	141629.273	3807.505	.657	37.197	.000	.580	1.723
	X2	18425807.354	4507396.158	.073	4.088	.000	.575	1.739
	X3	917747.243	729982.379	.017	1.257	.209	.995	1.005
	X4	-6592.704	38606.036	-.002	-.171	.864	.992	1.008
	D51	-42212505.350	25956331.549	-.023	-1.626	.104	.931	1.074
	D52	-80853090.927	36590821.142	-.031	-2.210	.027	.940	1.064

Dependent Variable:
Energy Consumption (Y)

Independent Variable:

1. floor area (X1)
2. storey (X2)
3. age (X3)
4. number of occupant (X4)

Dummy Variables:
Tropical Monsoon (D51)
Tropical Savanna (D52)
Tropical Rainforest (D53)

Pearson Correlation < 0.7
Variance Inflation Factors (VIF) < 10

Indicates no problem with multicollinearity

Phase 1 – Regression Analysis

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.710[a]	.504	.503	593972641.308418200000000

a. Predictors: (Constant), D52, X4, X3, X1, D51, X2

b. Dependent Variable: Y

Model		Unstandardized Coefficients		t	Sig.
		B	Std. Error		
1	(Constant)	10016273.695	25914889.648	.387	.699
	X1	141629.273	3807.505	37.197	.000
	X2	18425807.354	4507396.158	4.088	.000
	X3	917747.243	729982.379	1.257	.209
	X4	-6592.704	38606.036	-.171	.864
	D51	-42212505.350	25956331.549	-1.626	.104
	D52	-80853090.927	36590821.142	-2.210	.027

a. Dependent Variable: Y

Finding 3:

X1 and X2 have positive correlation to Y and both are statistically significance

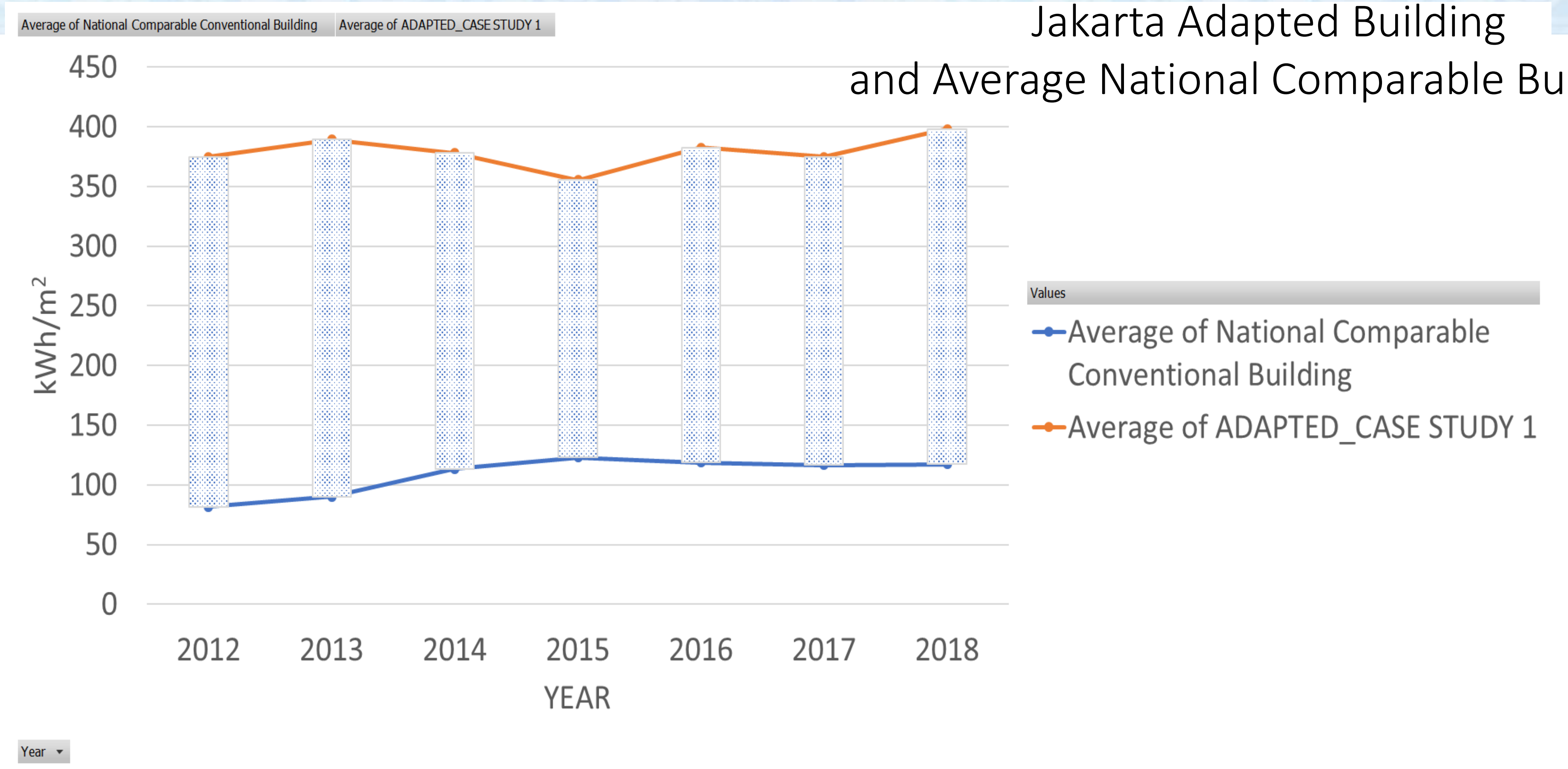
D51 and 52 has a negative correlation to Y means that **Energy Consumption is lower** for Tropical Monsoon (D51) and Tropical Savanna (D52) than for Tropical Rainforest (D53).

Research objective 3

To evaluate Indonesian public buildings adaptation projects

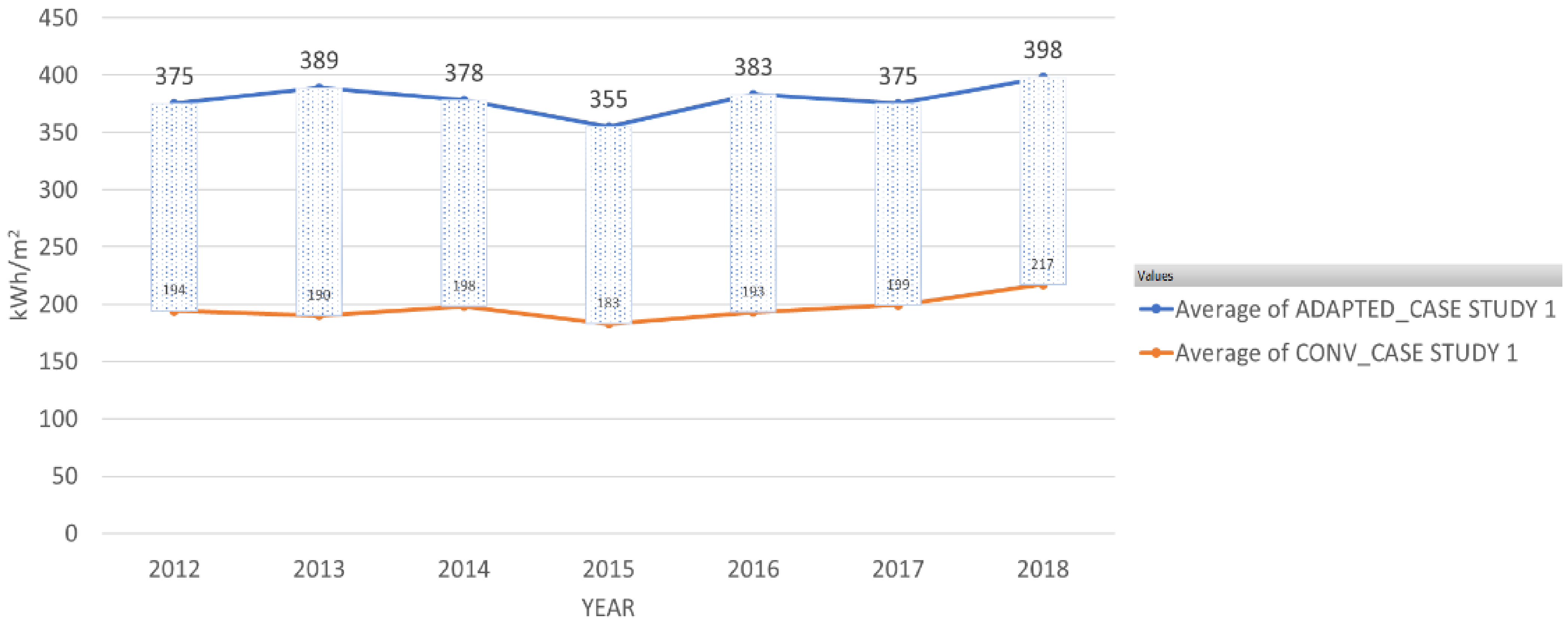
CASE STUDY 1: JAKARTA

Gap of Energy Use (kWh/m^2)
Jakarta Adapted Building
and Average National Comparable Buildings



Qualitative Data:

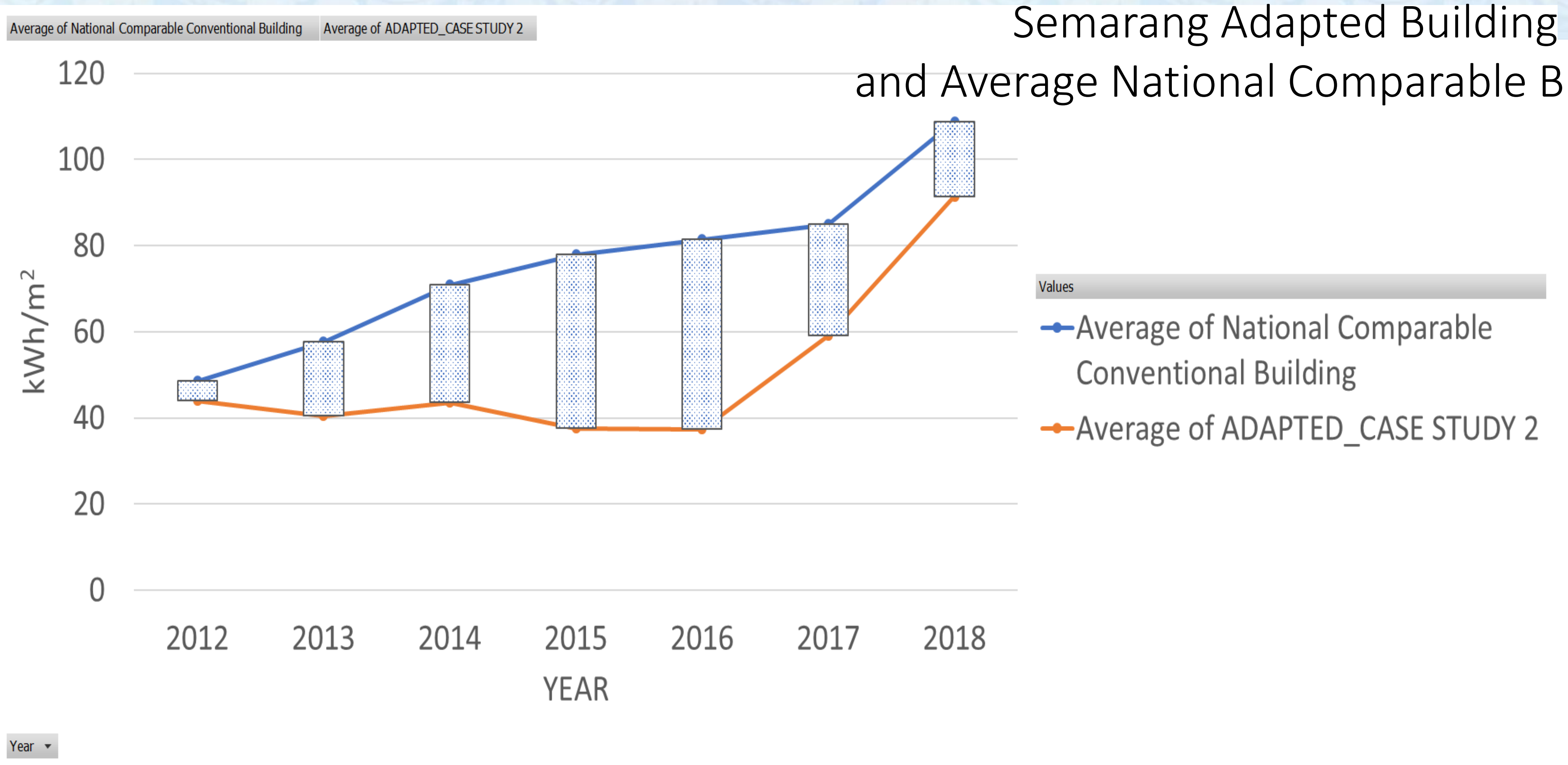
1. Indoor Temperature is hot, and glare from sunlight
2. Solar panels does not perform well



Gap of Energy Use (kWh/m^2)
Jakarta Adapted Building and Conventional Building

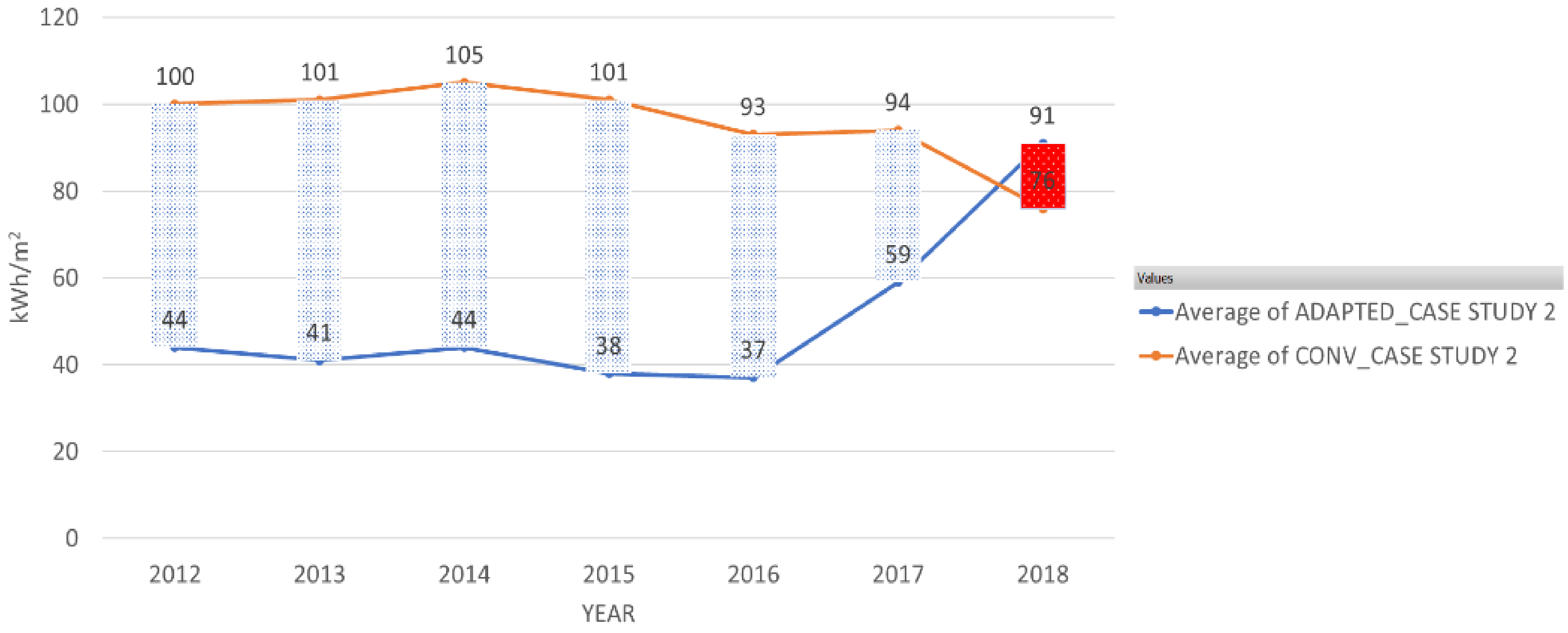
CASE STUDY 2: SEMARANG

Gap of Energy Use (kWh/m^2)
Semarang Adapted Building
and Average National Comparable Buildings



Qualitative Data:

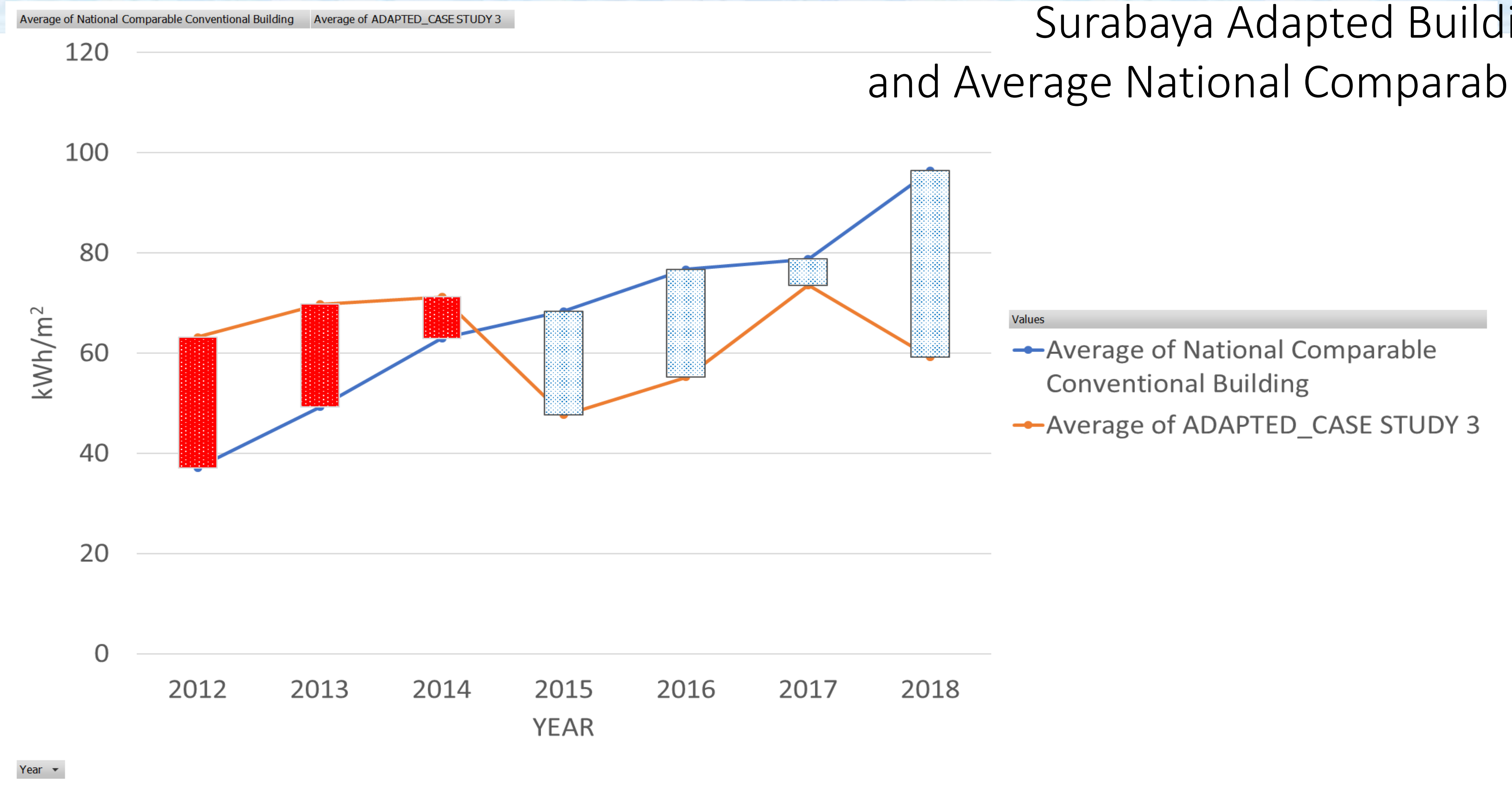
1. Limited fresh air circulation
2. New ACs have been installed
3. Sensors are not working properly



Gap of Energy Use (kWh/m^2)
Semarang Adapted Building and Conventional Building

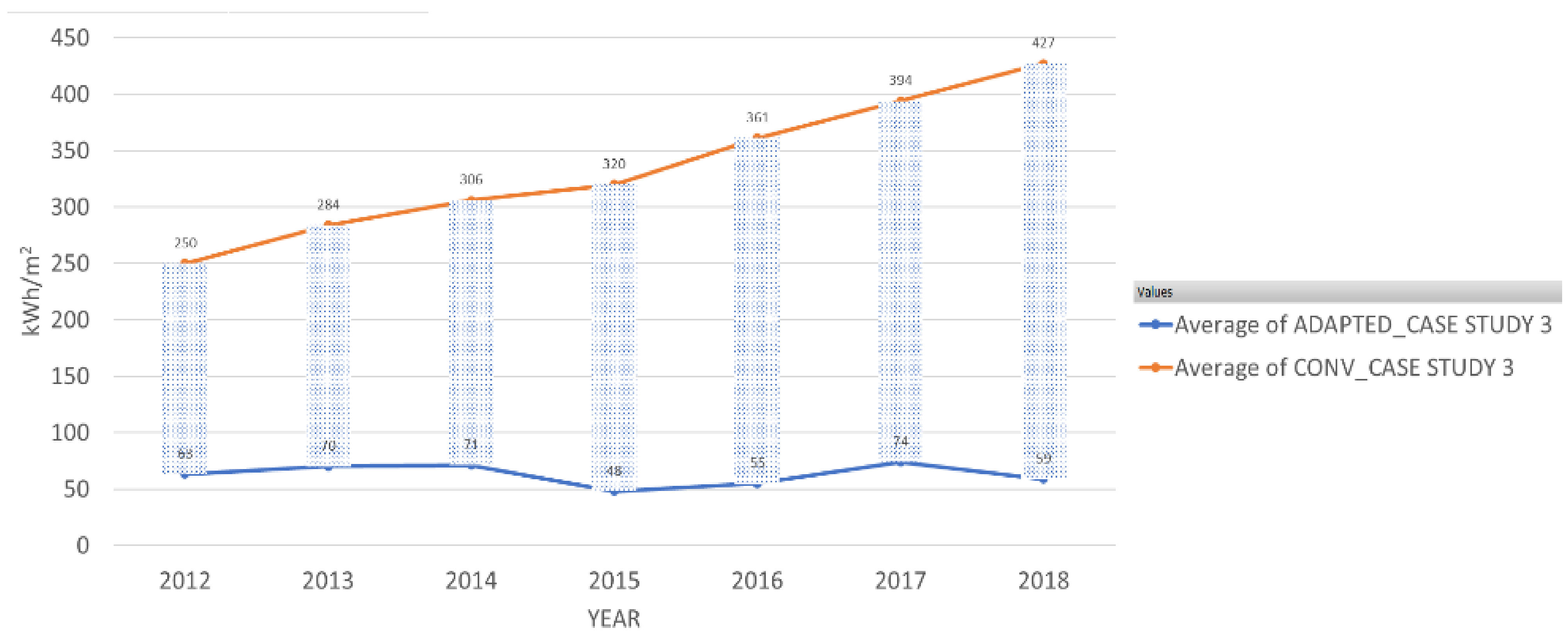
CASE STUDY 3: SURABAYA

Gap of Energy Use (kWh/m^2)
Surabaya Adapted Building
and Average National Comparable Buildings



Qualitative Data:

1. Using fresh air circulation
2. Low maintenance cost



Gap of Energy Use (kWh/m^2)
Surabaya Adapted Building and Conventional Building

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Research Conclusion

1. Indonesian public buildings average electricity use and inefficiency increased from 2012 to 2018. In contrast, the average electricity use of buildings in G20 representative countries continuously decreased during this period.

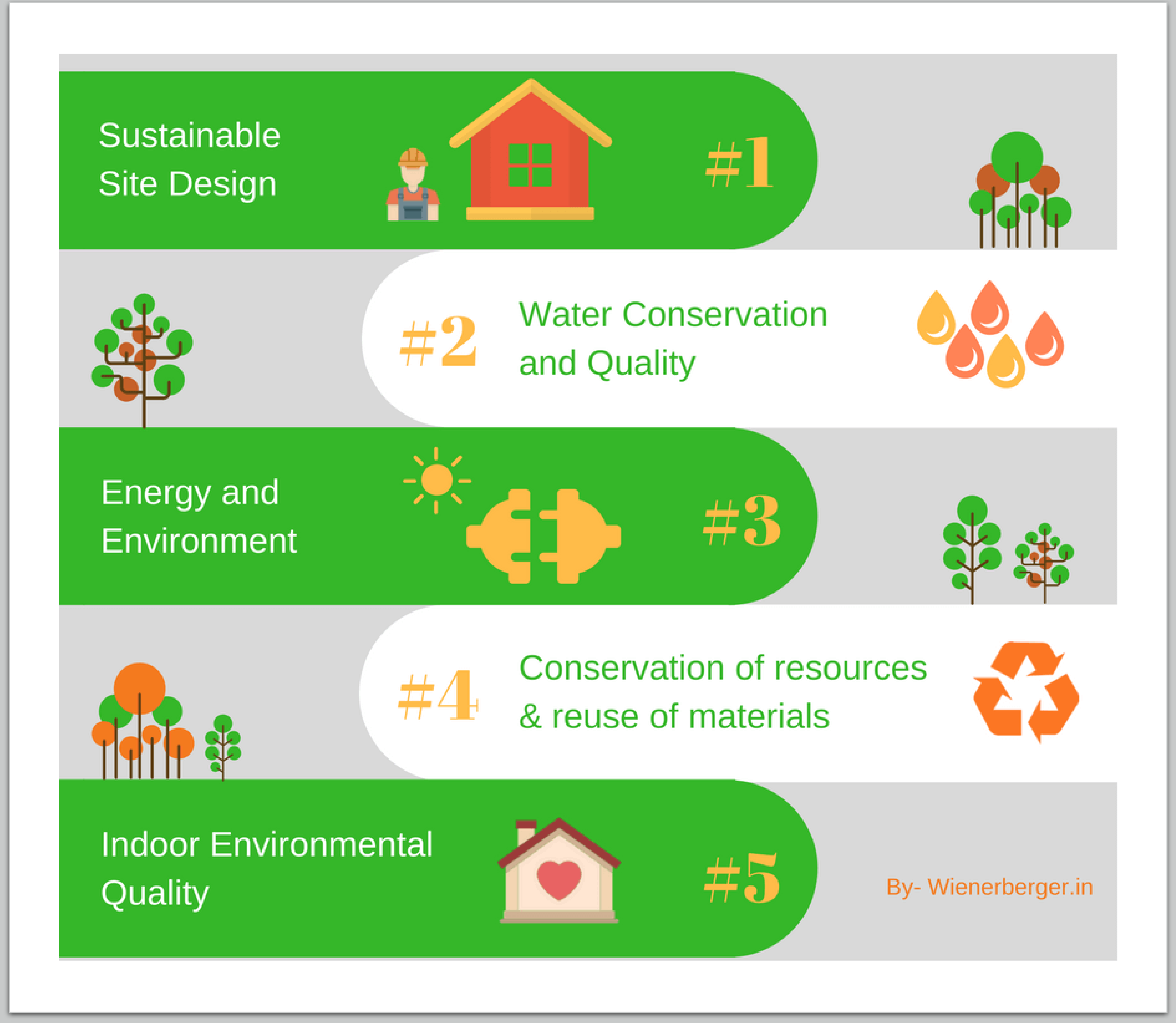
2. The inefficient energy use in Indonesian public buildings was dominated by small and low-rise buildings, a building age between six and 50 years, and buildings in tropical rainforest regions.

3. Factors that positively influenced Indonesian public buildings energy consumption were floor area, number of storeys, building age, and number of occupants. In addition, different tropical climate classification had different impacts on building energy consumption.

4. Trends of electricity use and costs in case studies of public buildings adaptation projects indicated that some adaptation projects still had limited impact on efficiency of electricity use and cost.

For Valuer

Understanding element of sustainability in buildings and to what extent the buildings has successfully adapt green buildings principles such as building energy efficiency is important since it impact on the building value through their operational cost.



Green Value Concept

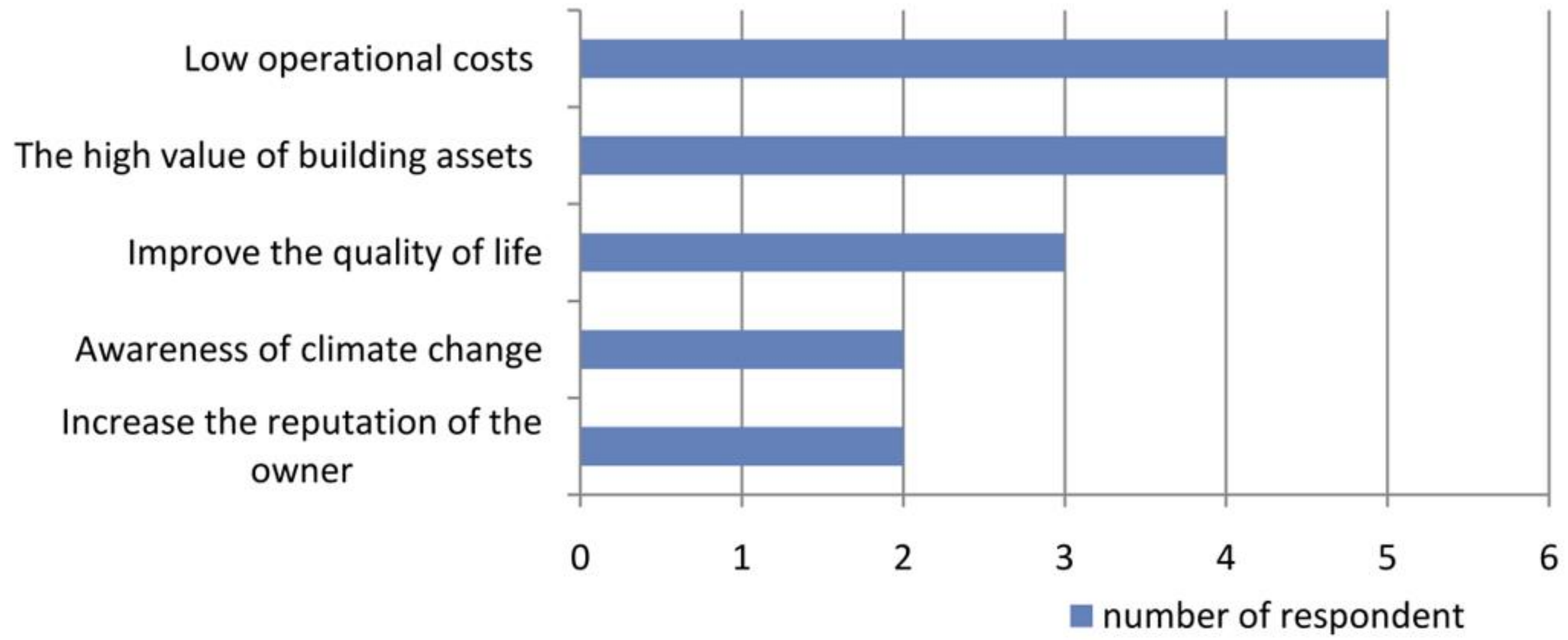
(Chris Corps, 2005)

1. Good for the environment;
2. Provide healthier places to live and more productive places to work;
3. Command higher rents and prices;
4. Attract tenants more quickly;
5. Reduce tenant turnover and cost less to operate and maintain.

Jakarta, Indonesia

The owners' motivation on green buildings

(Ririhena and Sujana, 2020)



(Green buildings' owners)

Penang, Malaysia

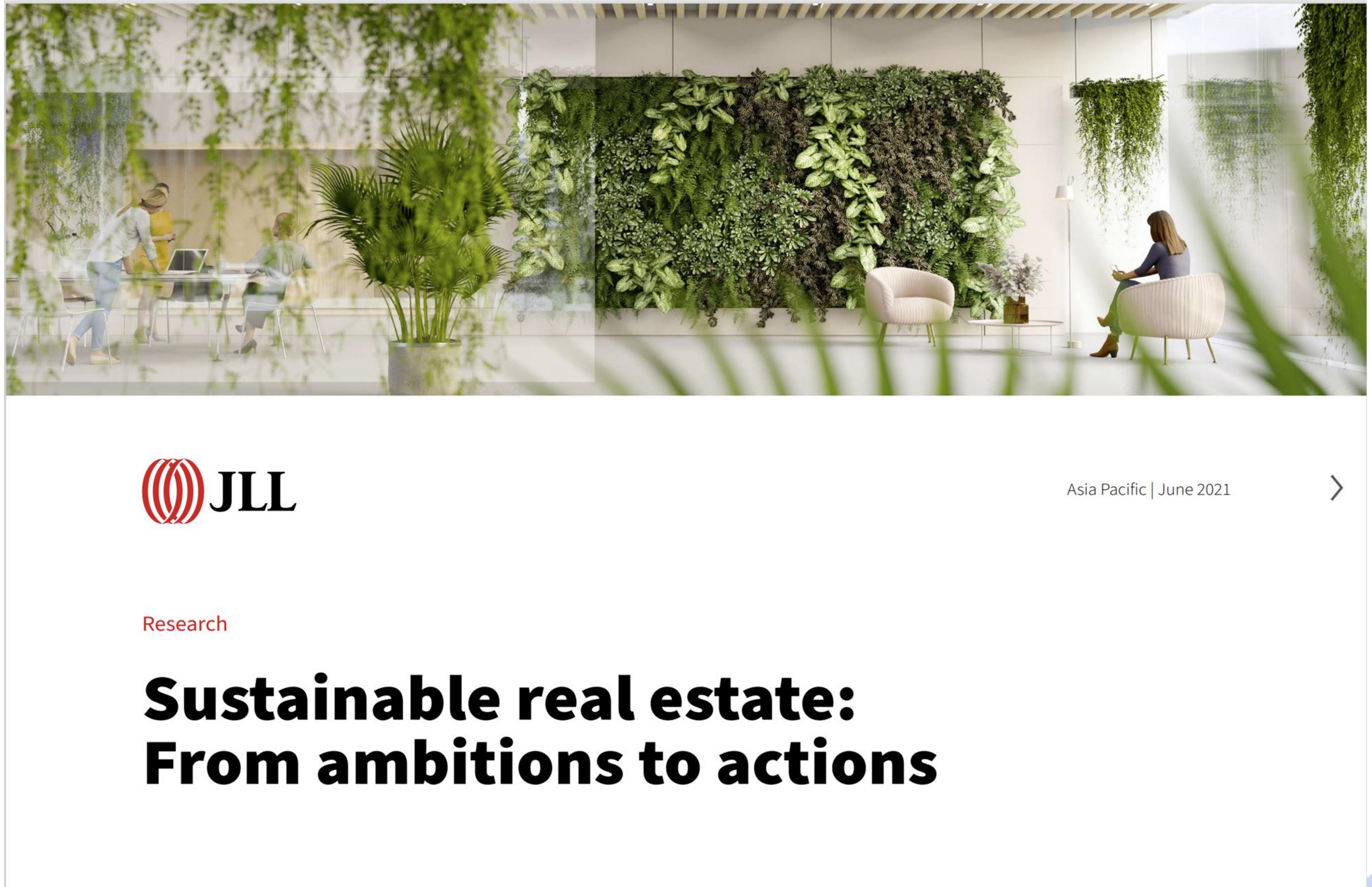
Approx 30% respondent perceive that Green building has higher value than the conventional, Hence, valuer should incorporate green element into valuation Practice.

(Abdullah et.al., 2018)

Asia Pacific

7 in 10 occupiers are willing to pay a rental premium to lease green buildings in the future. However, the current supply of green buildings is insufficient to meet the ambitious net zero targets set by occupiers.

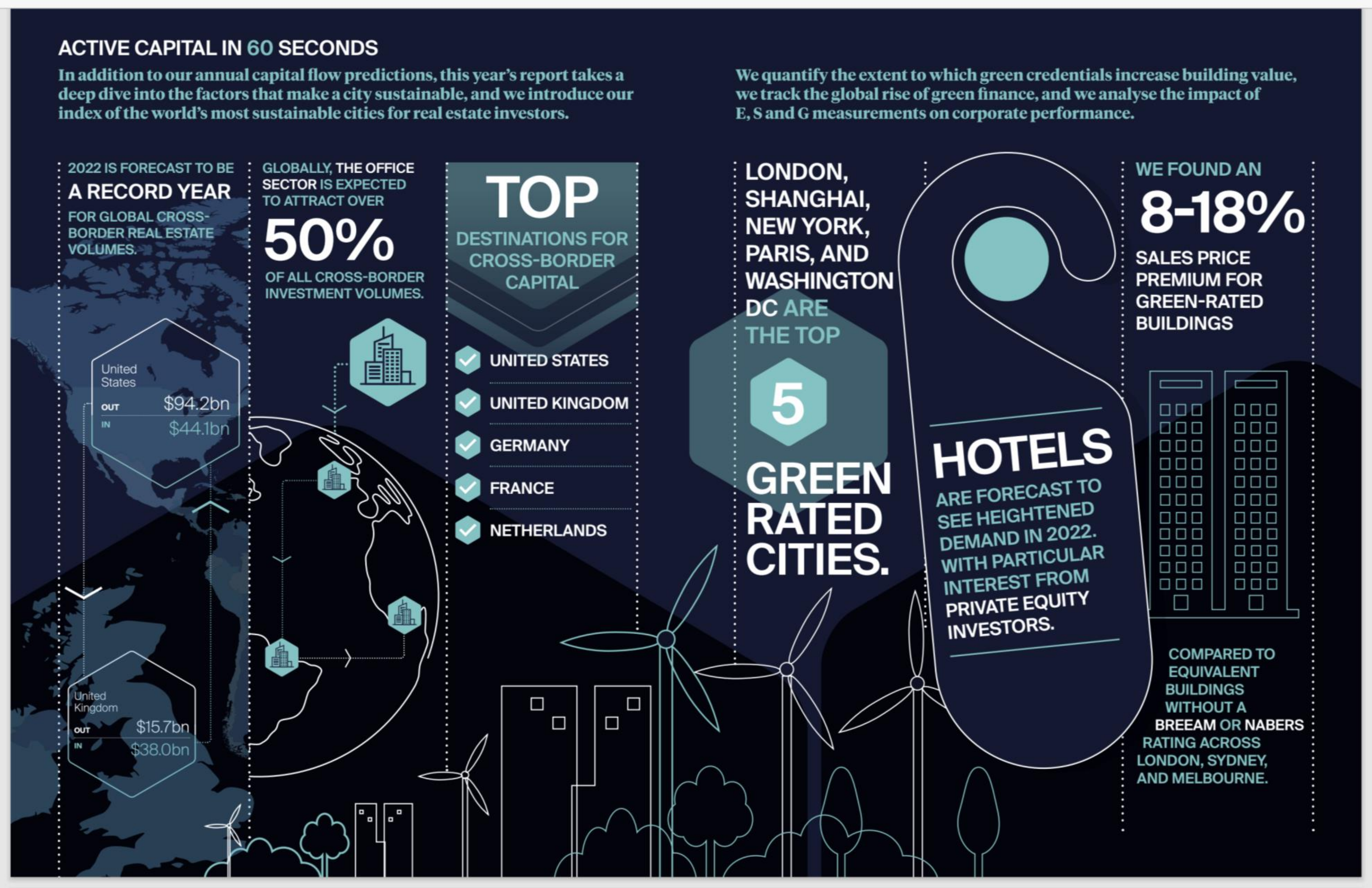
(JLL, 2021)



London, Sydney, Melbourne

8-18% sales price premium for green-rated buildings compared to equivalent buildings without a BREEAM or NABERS rating across these markets, depending on the level of green rating

(Kinght Frank, 2021)

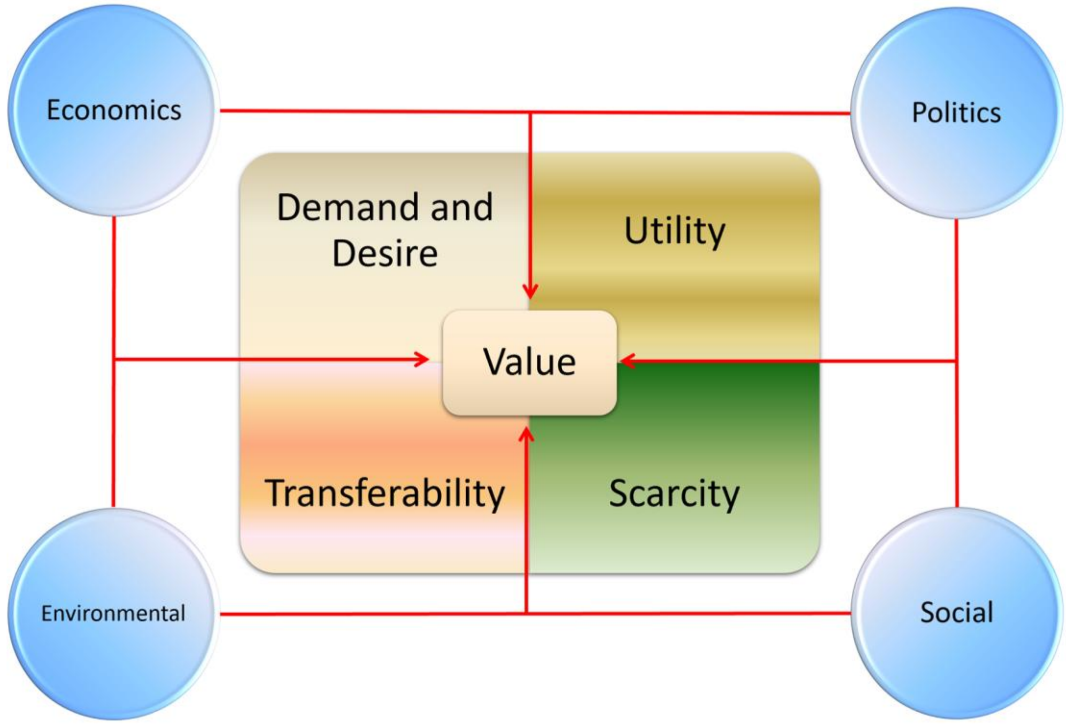


NOTES

1. Valuers have a role on interpreting the property market by taking into account factors, extending from macro and microeconomic factors, to social, environmental and also stakeholder actions, that all affect market value.

2. Challenges for valuers in incorporating sustainability is how to adequately assess and compare sustainability attributes between property, and how is this then reflected valuation calculation (gross or net rents, occupancy/vacancy, outgoings, rental growth, capitalization rates, and terminal yields).

3. Standard and guideline on sustainability inclusion in valuation practice may help valuers' performance on identifying green contribution to assets value.



“There can be no economy where there is no efficiency”

Benjamin Disraeli, UK Prime Minister 1868

Thank You

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