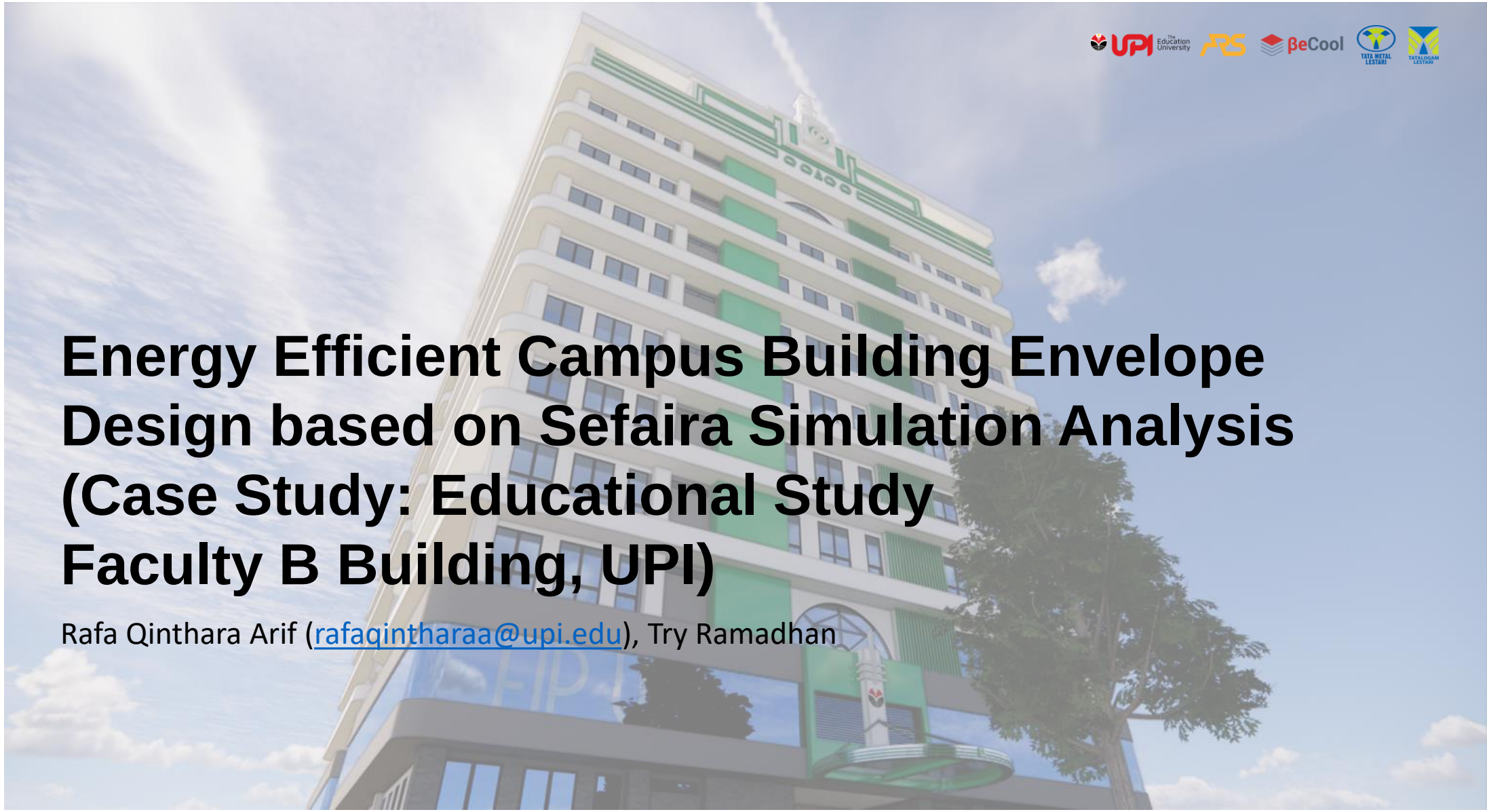

Universitas Pendidikan Indonesia

Energy Efficient Campus Building Envelope Design based on Sefaira Simulation Analysis (Case Study: Educational Study Faculty B Building, UPI)

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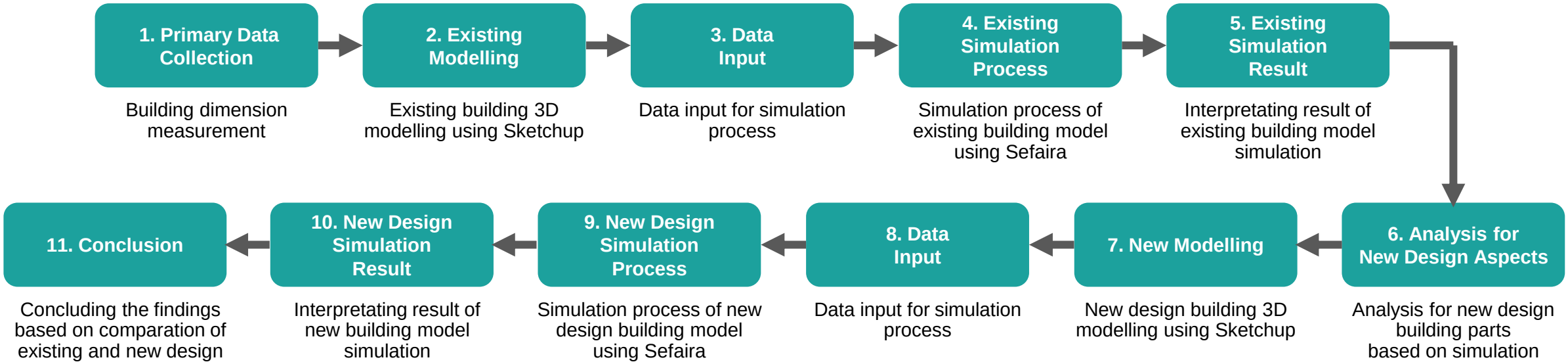
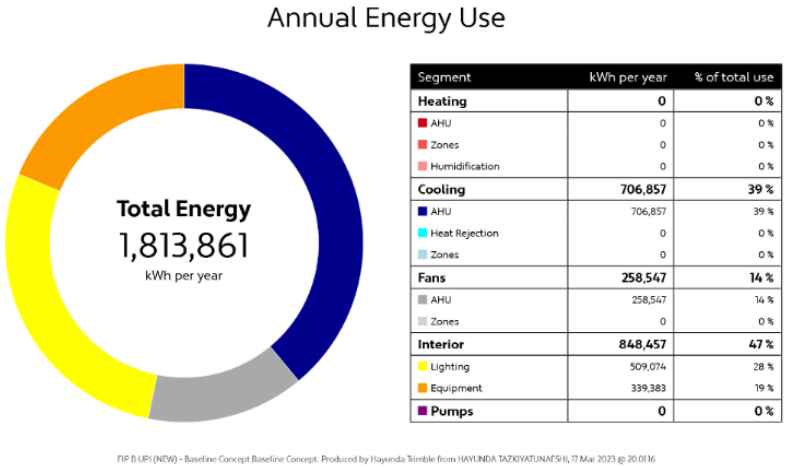
Introduction

- The building sector is an energy user that greatly influences energy consumption with a percentage of around 31% of total global consumption and around 22%-57% on average regionally and the numbers keep increasing.
- Energy consumption calculations can be carried out manually through Overall Thermal Transfer Value (OTTV) calculations or through Sefaira Architecture software calculations by simulation on the building's envelope.
- Envelope design can showcase the building's energy performance number based on envelope's simulation results.
- The study use UPI's largest building Faculty of Educational Study (FIP) B building envelope model to determine the energy performance and aim to redesign the envelope to sight if the building could be more energy efficient.

Method

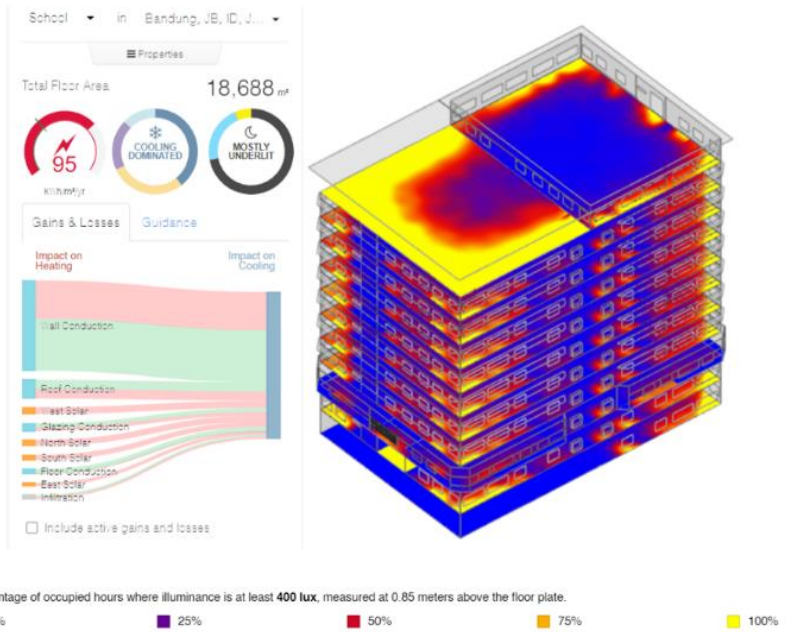

1. Primary Data Collection
Building dimension measurement
2. Existing Modelling
Existing building 3D modelling using Sketchup
3. Data Input
Data input for simulation process
4. Existing Simulation Process
Simulation process of existing building model using Sefaira
5. Existing Simulation Result
Interpretating result of existing building model simulation
6. Analysis for New Design Aspects
Analysis for new design building parts based on simulation
7. New Modelling
New design building 3D modelling using Sketchup
8. Data Input
Data input for simulation process
9. New Design Simulation Process
Simulation process of new design building model using Sefaira
10. New Design Simulation Result
Interpretating result of new building model simulation
11. Conclusion
Concluding the findings based on comparation of existing and new design

Existing Simulation



Segment	kWh per year	% of total use
Heating	**0**	**0 %**
AHU	0	0 %
Zones	0	0 %
Humidification	0	0 %
Cooling	**706,857**	**39 %**
AHU	706,857	39 %
Heat Rejection	0	0 %
Zones	0	0 %
Fans	**258,547**	**14 %**
AHU	258,547	14 %
Zones	0	0 %
Interior	**848,457**	**47 %**
Lighting	509,074	28 %
Equipment	339,383	19 %
Pumps	**0**	**0 %**

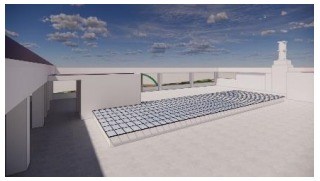
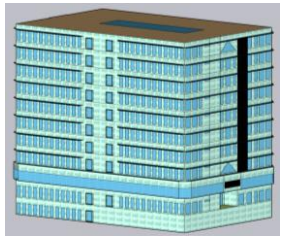
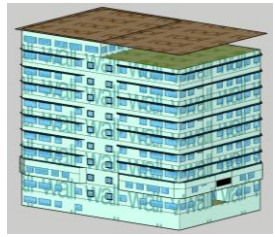
FIP B UPI (NEW) - Baseline Concept Baseline Concept. Produced by Hayunda Trimble from HAYUNDA TAZKIYATUNAFSIH, 17 Mar 2023 @ 20:01:16



- Based on the simulation results of the existing FIP B UPI Building model approach, it was found that the total energy required for building operations is 1,813,861 kWh per year.
- Through Sefaira, it was found that building's natural lighting tend to be mostly underlit at 72%, well lit at 22%, and overlit at 6% of 400 lux for the total floor area.

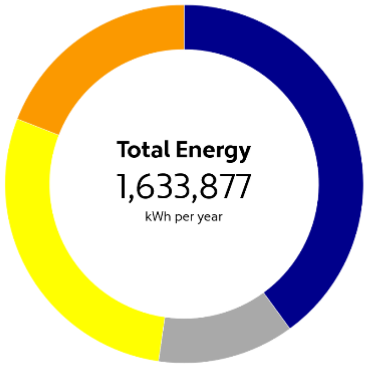
Analysis

New design arrangements based on these findings were carried out by comparing the changes made between the existing envelope design and the new envelope design preferences.

No.	Design Aspect Changes	Existing Condition	Objective
1.	Skylight Addition 	Full rooftop with partial use as a closed space. 	Provide access for natural sunlight and air circulation to inside.
2.	Subtraction of the central mass of the building to form the atrium. 	The central space of the building is closed And functioned as a connecting corridor only. 	Provide wide access to the core of the building.
3.	Glaze to wall ratio of 33.26% from the façade wall. 	Glaze to wall ratio of 18.84% from the façade wall. 	Increase natural light access from the building façade.

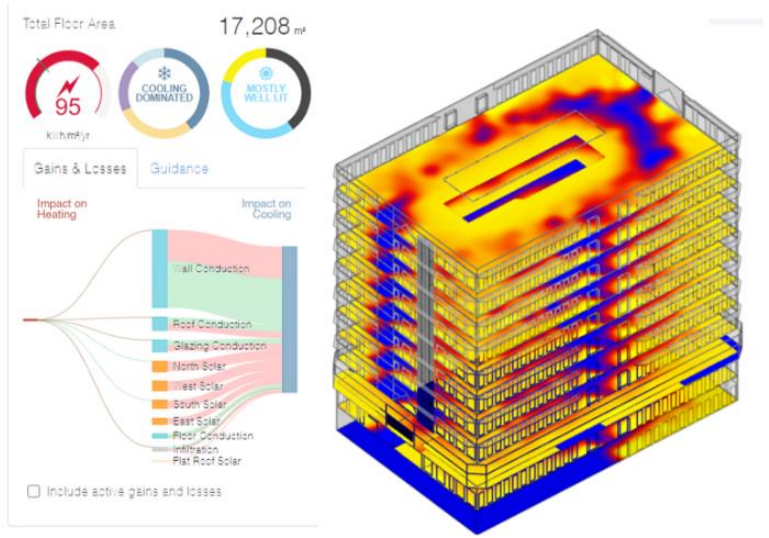
Result and Discussion

Annual Energy Use



Segment	kWh per year	% of total use
Heating	**0**	**0 %**
AHU	0	0 %
Zones	0	0 %
Humidification	0	0 %
Cooling	**652,875**	**40 %**
AHU	652,875	40 %
Heat Rejection	0	0 %
Zones	0	0 %
Fans	**201,540**	**12 %**
AHU	201,539	12 %
Zones	1	0 %
Interior	**779,462**	**48 %**
Lighting	467,677	29 %
Equipment	311,785	19 %
Pumps	**0**	**0 %**

TIP NEW DONE - Baseline Concept. Produced by Hayunda Trimble from HAYUNDA TAZKIYATUNAFSI II, 18 Mar 2023 @ 13:13:45



Percentage of occupied hours where illuminance is at least **400 lux**, measured at 0.85 meters above the floor plate.

0% 25% 50% 75% 100%

- The redesigned model simulation result show it has the total energy required for building operations of 1,633,877 kWh per year.
- Through Sefaira, it was found that building's natural lighting tend to be mostly well lit at 40%, over lit at 20%, and underlit at 20% of 400 lux for the total floor area.

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Conclusion

- Sefaira's simulation shows that the new building model experiences energy efficiency compared to the existing building approach model in which the energy consumption decreases by around 9.923%.
- The subtraction of the mass to become an atrium with its main void caused a reduction in the floor area of the building from 18,866 m2 to 17,208 m2 or around 8.78% reduction of the floor area.
- On average, energy consumption per floor has not seen much significant change, namely from 96,144 kWh/year per m2 to 94,948 kWh/year per m2 or only 1.26% reduction. These values are of course still far from the 2030 Energy Challenge target which pushes energy consumption to 46 kWh/year per m2, so other strategies are needed to reduce the value of energy consumption in the Faculty of Educational Study B Building, UPI.