



Design of a Highly Reliable Microgrid For KFUPM Campus

Mohammed S. Al Amri

Abdurahman Al Kalbi

Abdurahman S. Asiri

Mohannad Al Saawi

Mujtaba Al Qaffas

Advisor: Dr. Al-Muhaini

- The project is aimed to design a Microgrid for the KFUPM campus.
- The main objective of this project is divided in to three parts as following:
 - To evaluate the reliability of the current system.
 - To improve the current system by injecting the Microgrid system.
 - To simulate the new system and compare with the current system.

CURRENT SYSTEM EVALUATION

In system evaluation we use a survey to have a result that will help us in the evaluation. We did a strategy to divide the KFUPM campus into these types of customers load :

- Clinic.
- Academic & Administration Facilities.
- Student Housing.
- Family Housing.

We have distributed the survey in all the bulletin boards inside the campus . We also distributed it online in skfupm website and twitter. Samples of the survey questions are seen in the next figures:

The longest duration for an interruption:in minutes

How satisfied are you with the electrical power service in terms of interruptions?

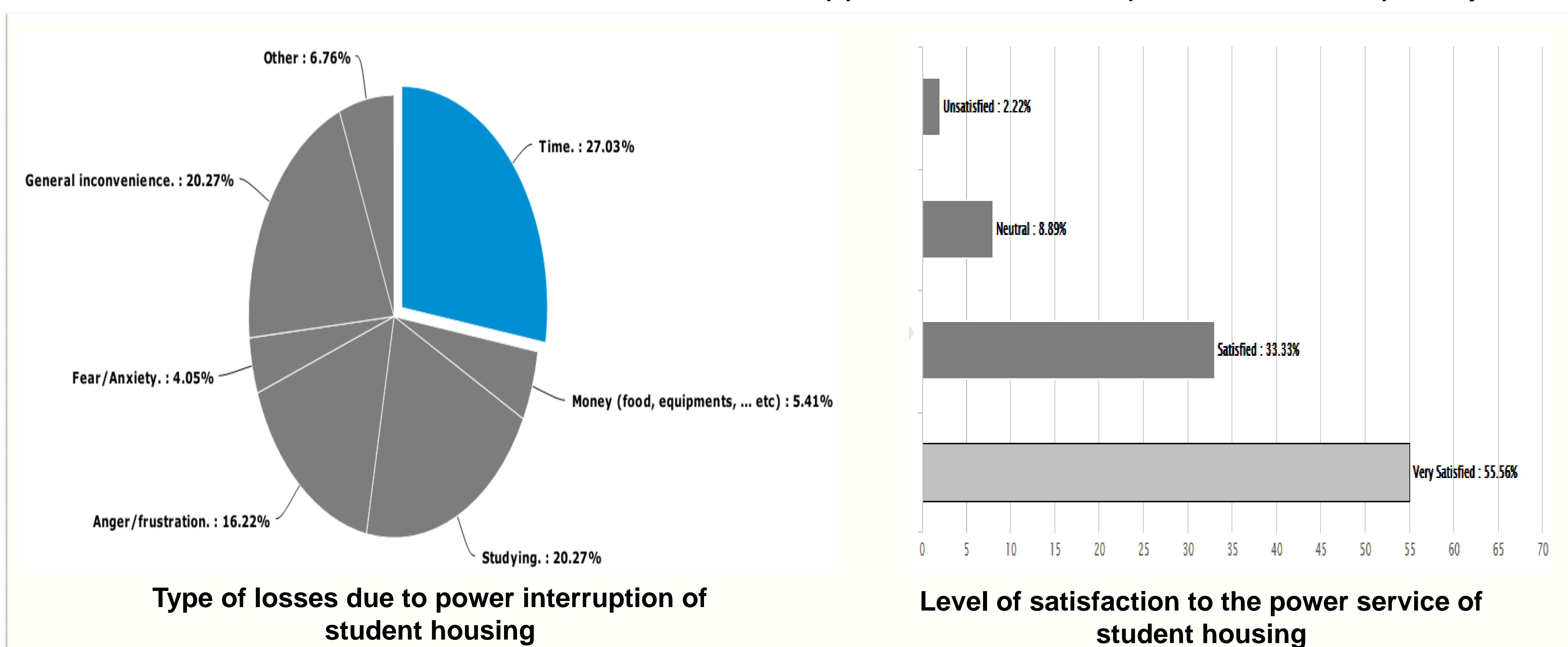
In which customer service do you work?

Very Unsatisfied, Unsatisfied, Neutral, Satisfied, Very Satisfied

Restaurant, Gas station, Market, KFUPM Mall, Laundry, Other

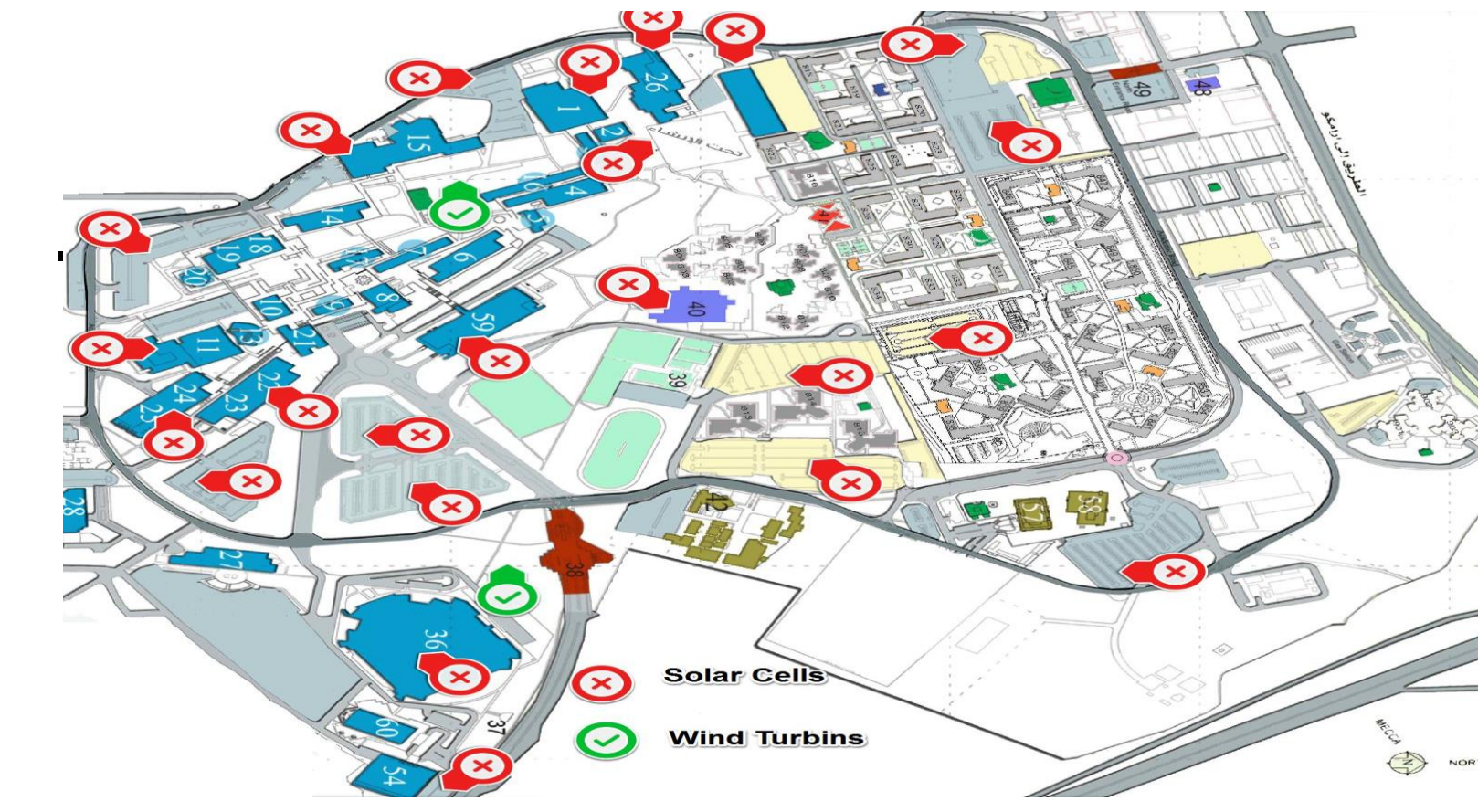
We will use the student housing load to show our evaluation and improvement results. The survey results should achieve these goals:

- To know the number of interruptions of KFUPM campus in specific period.
- To know the types of losses due an interruption.
- To know where most of the losses will happen due an interruption to set it as priority.



IMPROVEMENT OF CURRENT SYSTEM BY INTRODUCING MICROGRID

The KFUPM current system will work as Microgrid using renewable energy to avoid any interruption and reduce the duration of an interruption. We have used wind energy for family housing and solar energy for others. The potential locations for solar and wind energy are displayed in the following pictures:



Potential locations for solar cells



Potential locations for wind turbines

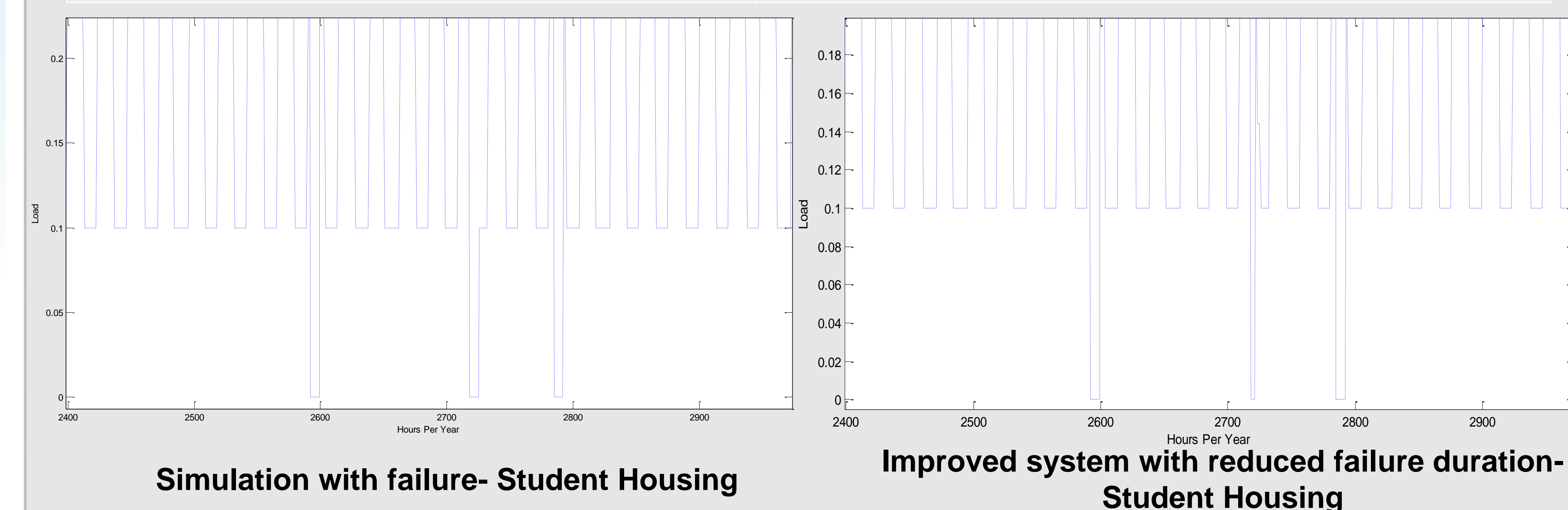
MATLAB SIMULATION

We made a MATLAB code that generate a random failure for the current system and compare the result after we install the Microgrid to the system. The reliability is measured according to these equations:

$$\text{System Availability} = \frac{MTTF}{MTTF + MTTR} \quad \text{System Unavailability} = 1 - \frac{MTTF}{MTTF + MTTR}$$

The results of availability for current system and availability for improved system are shown in the next table and figures.

CUSTOMER	AVAILABILITY FOR CURRENT SYSTEM	AVAILABILITY FOR IMPROVED SYSTEM
CLINIC	0.9820	0.9872
ACDIMIC & ADMINISTRATION BUILDING	0.9820	0.9829
FAMILY HOUSING	0.9820	0.9837
STUDENT HOUSING	0.9820	0.9836



Conclusions: Nowadays, power system of KFUPM is experiencing a number of failures that effect life routines of faculty, staff, students and all the university residents. This problem of power interruptions should be minimized to avoid any further problems that may appear as result of interruptions. For whom can refer to this report in the future regarding this issue, it offers basic information about the problem and how to reduce its effects. It shows how to benefit from renewable energy sources such as wind and solar energy by inserting Microgrid to the current power system. Simulation test provide that failure duration can be reduced as a result of installing Microgrid. Renewable energy equipments could cost a lot of money, however, the benefit gained from using this energy worth it. The question now is if we can think outside the box to find out how to use environment sources to make our lives go smoothly with the least amount of obstacles.

Acknowledgements: We would like to take the chance to thank Dr. Mohammed Al Muhaini for his continues support during the period of conducting this project. He was helpful and always was ready to guide us through the semester.