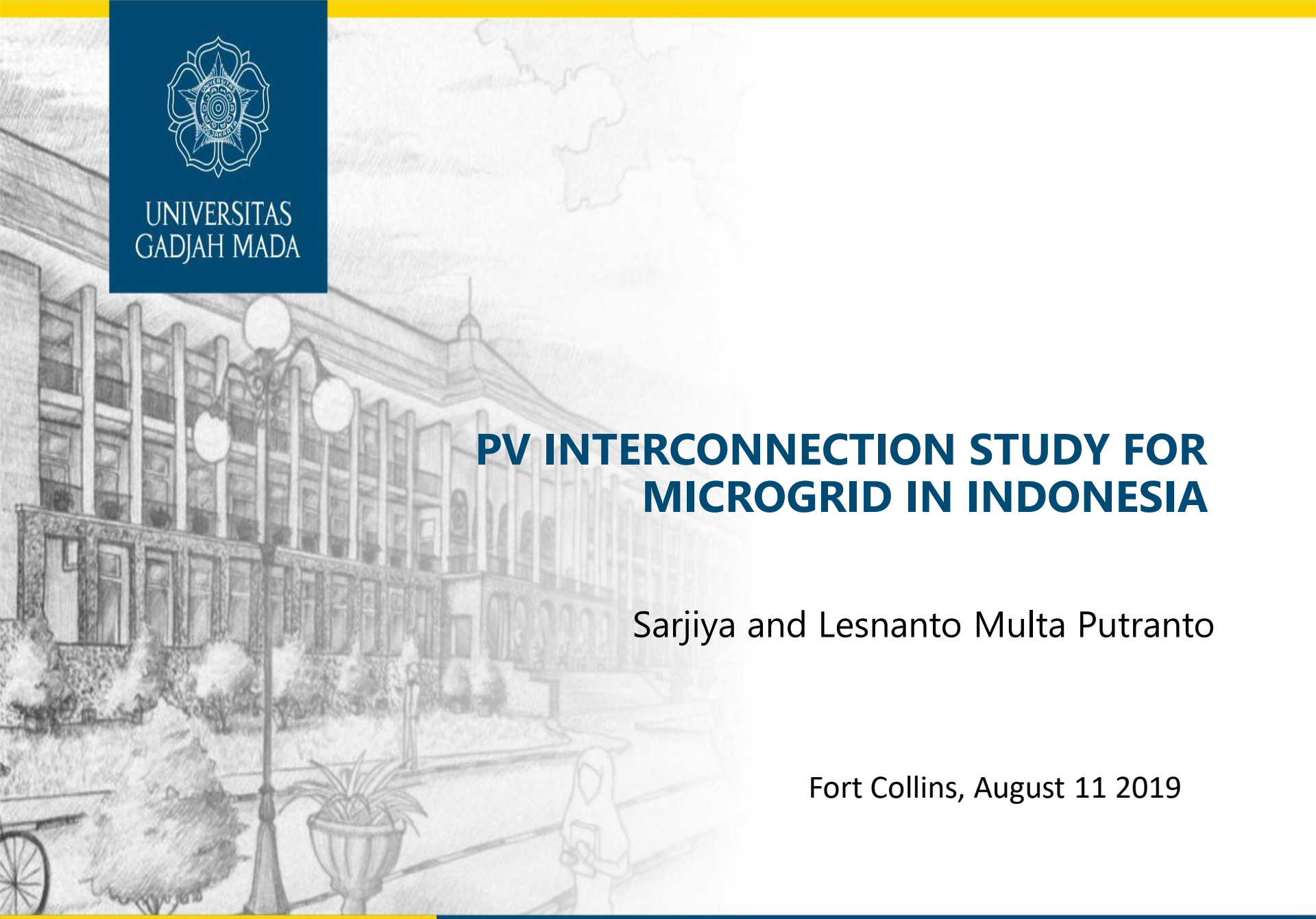

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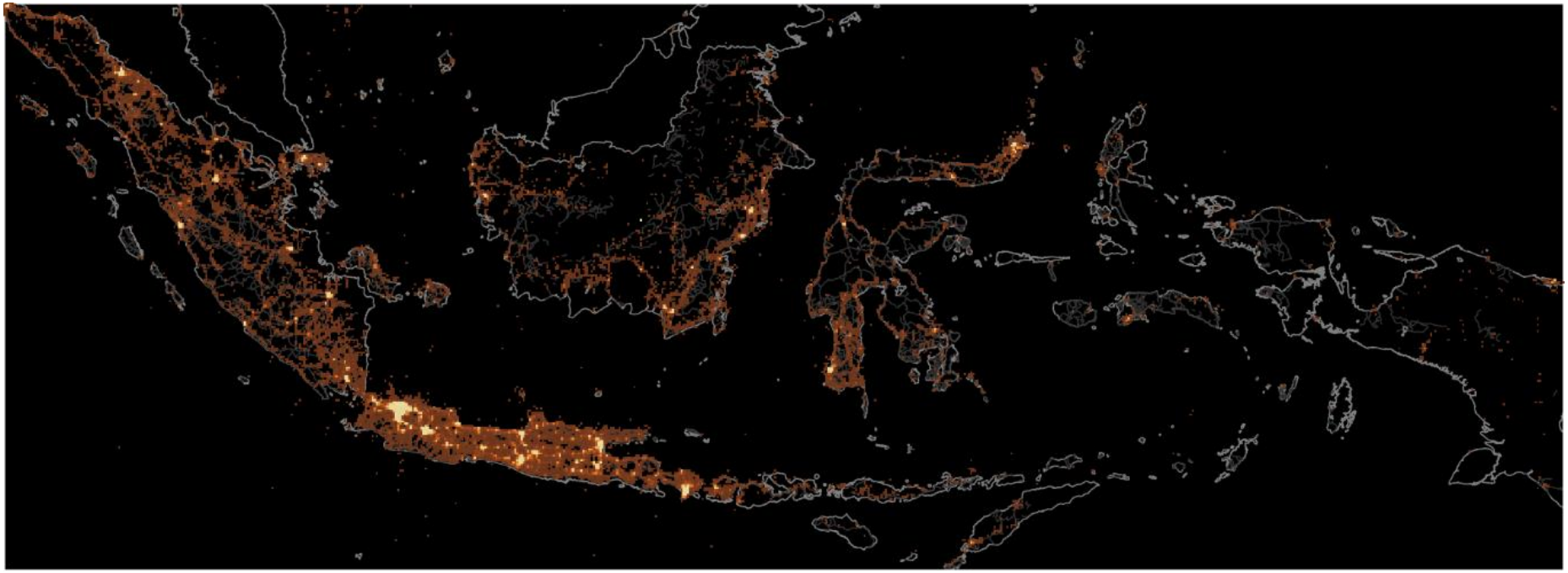
PV INTERCONNECTION STUDY FOR MICROGRID IN INDONESIA

Sarjiya and Lesnanto Multa Putranto

Fort Collins, August 11 2019

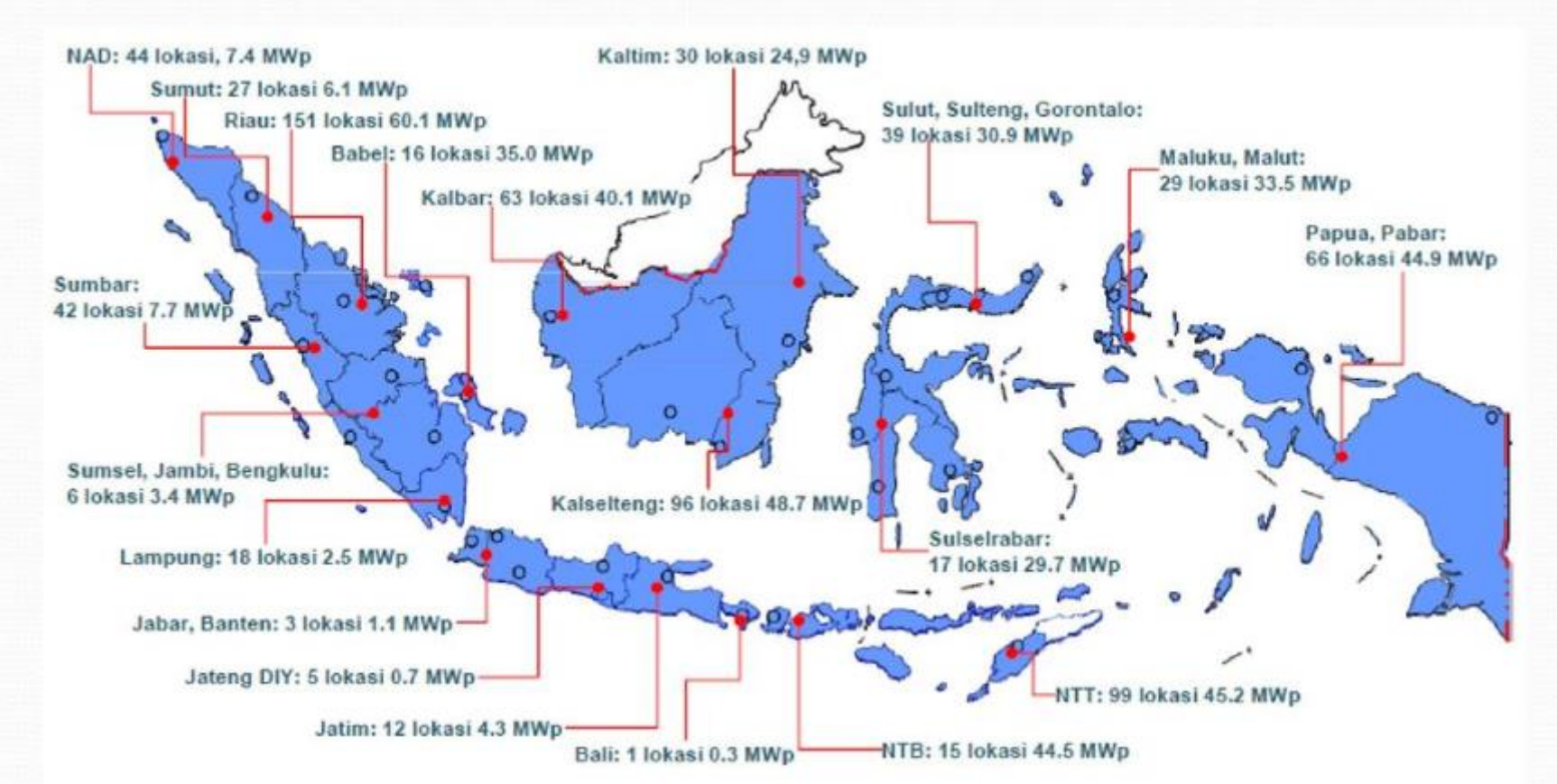
Introduction

- **Renewable Energy (RE) has the energy mix target 23% (in 2025) and 31% (in 2050) (No. 30 of 2007 on Energy).**
- **RE is very precisely applied in microgrid (MG), due to intermittent.**
- **MG for energy sovereignty in special area and remote island (portable and scalable).**
- **MG has a lower cost (no transmission line as conventional thermal generator).**



Government Program

1000 MWp PV farm program



Indonesia has **16,056 islands** with **8 major power networks** and **more than 600 isolated systems**.

Electrification in Indonesia reached **95.35% in 2017**

Source	Potential Power Generation
Hydropower	75 GW
Geothermal	29 GW
Biomass	33 GW
Solar Photovoltaic ("PV")	208 GWp (4.80 kWh/m2/day)
Wind Power	61 GW (3 – 6 m/s)
Ocean	18 GW

Source: Indonesian Ministry of Energy 2016

The **biggest potential of renewable power plant** in Indonesia is **solar photovoltaic or PV** with the potential power of **208 GWp**.

A study that will be discussed is a PV interconnection in Kupang.

Item	Remarks
Location	Oelpuah Village
System Loads	25 MW
Total Generating Capacity	43 MW
PV Size	5 MWp
Inverter Operating Voltage	160 – 280 VAC
Asset	Independent Power Producer
Feasibility Study	PT LEN (National Consultant)
Voltage Level	20 kV
COD	2015

OVERVIEW: PV IN KUPANG PT. PLN

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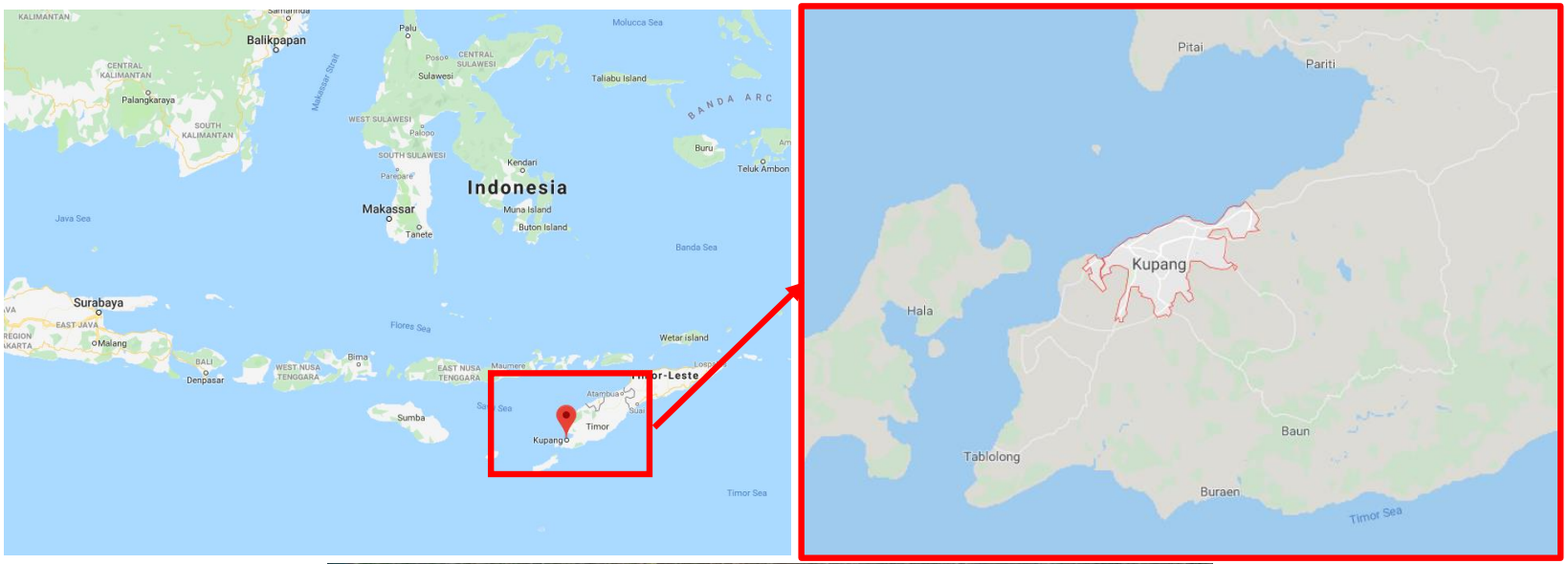
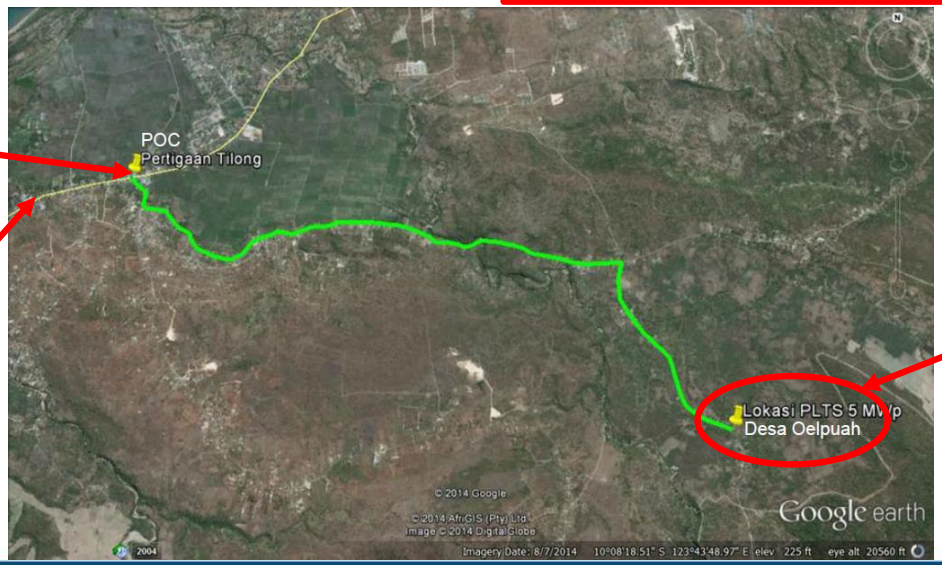


Point of common coupling (POC) of PV with 20 kV network

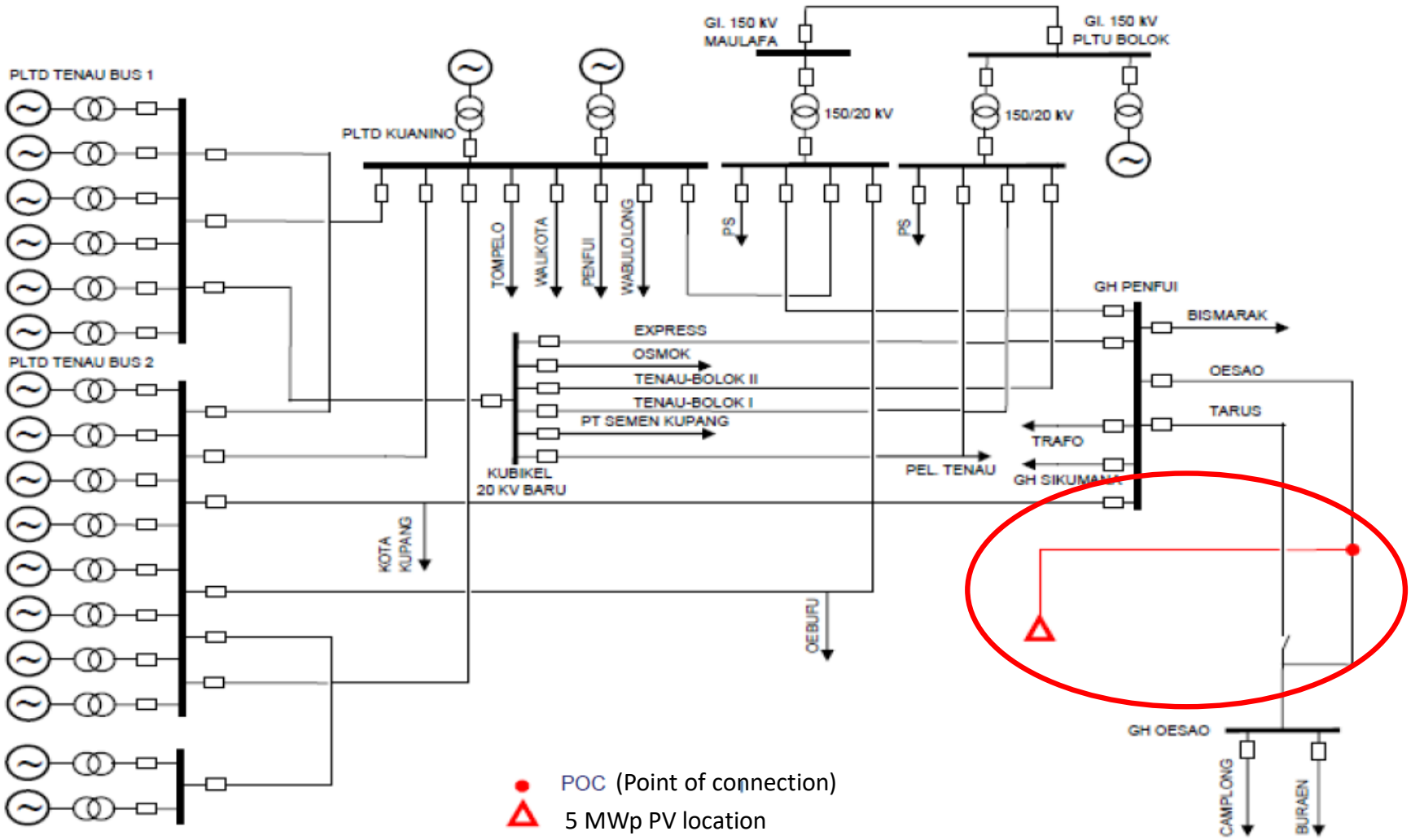
20 kV distribution network



PV installation point, 6 KM

Feasibility Study by

SINGLE LINE DIAGRAM (SLD) OF KUPANG SYSTEM



SLD OF 5 MWp PV SYSTEM IN KUPANG

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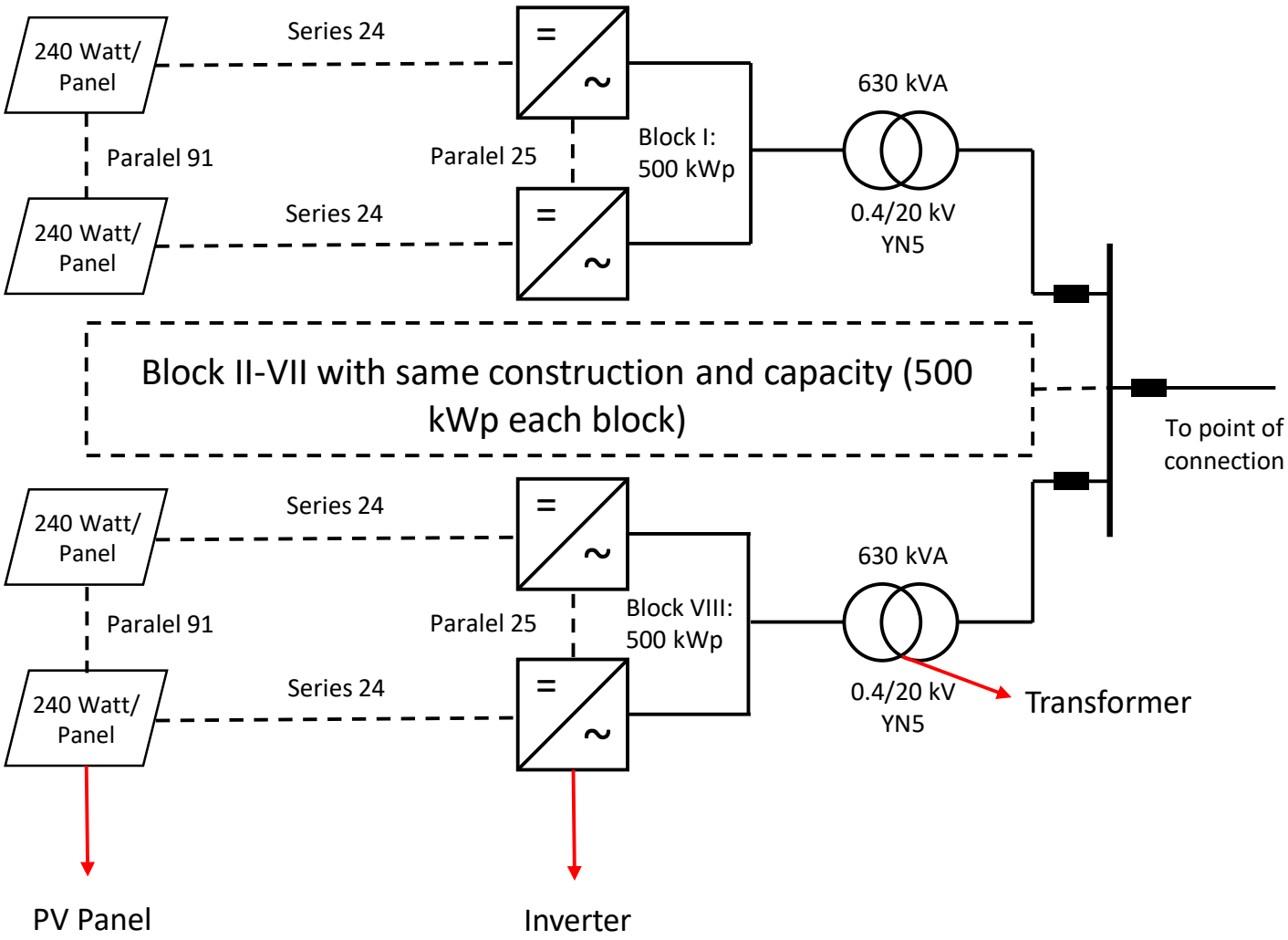

PV POTENTIAL

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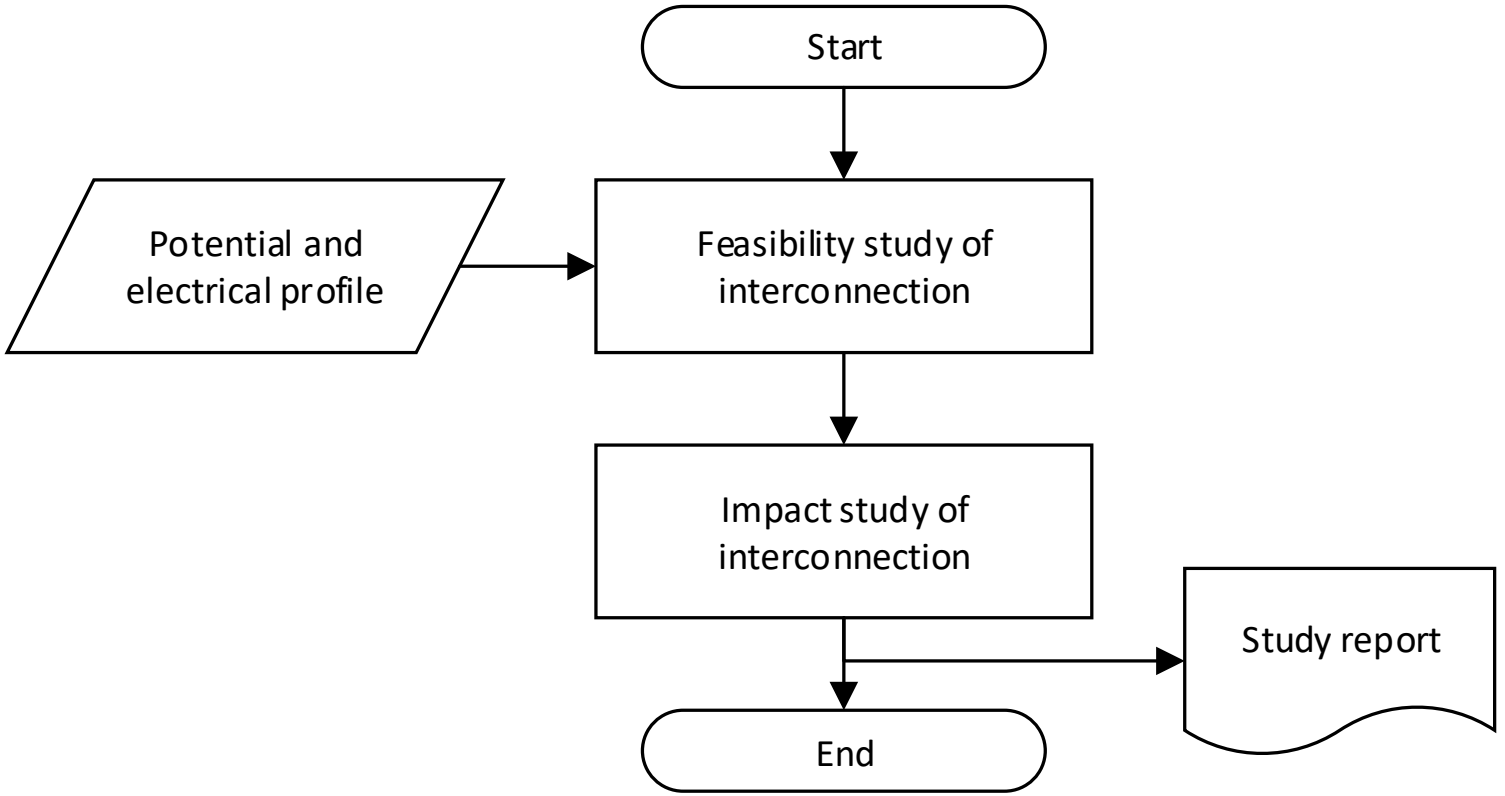
Source: NASA

Month	Irradiation (kWh/m^{2}day)
January	5.87
February	5.73
March	6.25
April	6.35
May	5.93
June	5.52
July	5.76
Augustus	6.53
September	7.21
October	7.54
November	7.25
December	6.41
Average	6.37

- Effective energy at the output of the array is 31.31 MWh/day
- Energy injected into the grid is 30.52 MWh/day
- Horizontal global irradiation is 7.440 kWh/m^{2}day

The potential energy of solar radiation in Kupang PV has an irradiation **average of 6.37 kWh /m^{2}day**.

METODOLOGY


Start
Potential and electrical profile
Feasibility study of interconnection
Impact study of interconnection
Study report
End

IMPACT STUDY OF PV INTERCONNECTION

After the interconnection of 5 MWp PV in Kupang, three studies will be discussed (load flow, short circuit, and transient). The result of this simulation are,

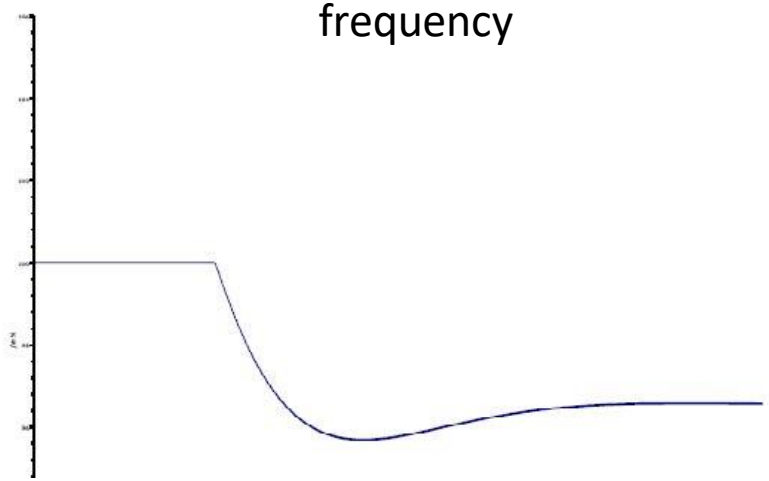
[1] **Load Flow**: The POC voltage is **19.93 kV** which means **an increase from 18.9 kV**. This increase in voltage is caused by PV supplies load at the end of the branch and minimizes voltage drop.

[2] **Short Circuit**: The **largest short circuit current** is **5.3 kA** which is still **below of the protection rating**.

[3] **Transient**: the case that discussed is when 5 MWp PV trip. The results from the study are the frequency will swing temporary because losing this power and the existing power plant quickly compensate this event.

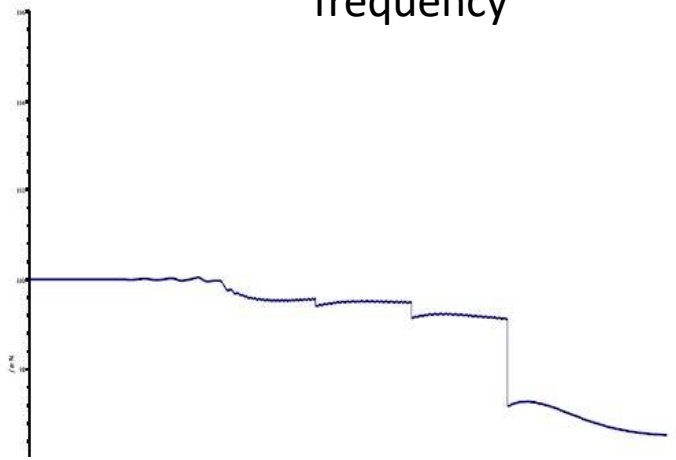
When 5 MWp PV is released instantly

frequency



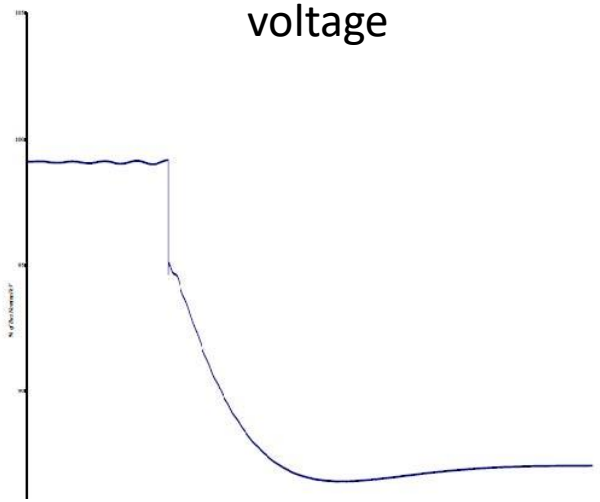
When 5 MWp PV is released slowly with a speed of 1 MWp loss in 15 seconds

frequency

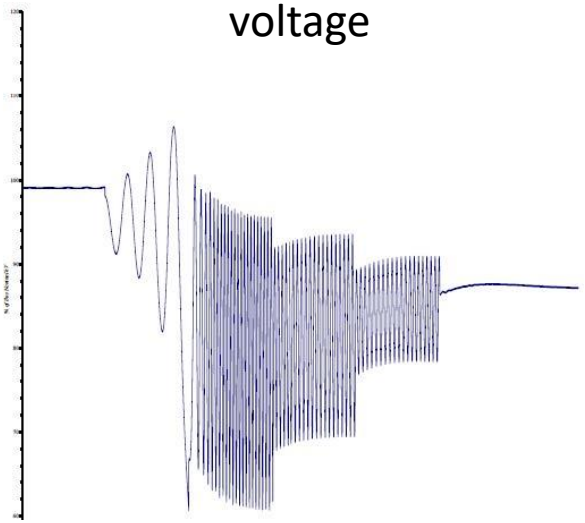


[3] **Transient**: the case that discussed is when 5 MWp PV trip. The results from the study are the voltage will drop that still in the range of quality criteria

When 5 MWp PV is released instantly



When 5 MWp PV is released slowly with a speed of 1 MWp loss in 15 seconds



Challenge

1. Intermittent of PV
2. Naturally Cloudy
3. Need Energy Storage System
4. High Operation Cost

UGM Microgrid Project

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1. Maximum PV Hosting Capacity of PV (2018)
2. Prototype of Microgrid Test Bed : Roll Royce(Ongoing)
3. Campus Green Energy Monitoring (Ongoing)
4. Masterplan of Maluku Papua (Ongoing)

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THANK YOU

LOCALLY ROOTED, GLOBALLY RESPECTED