

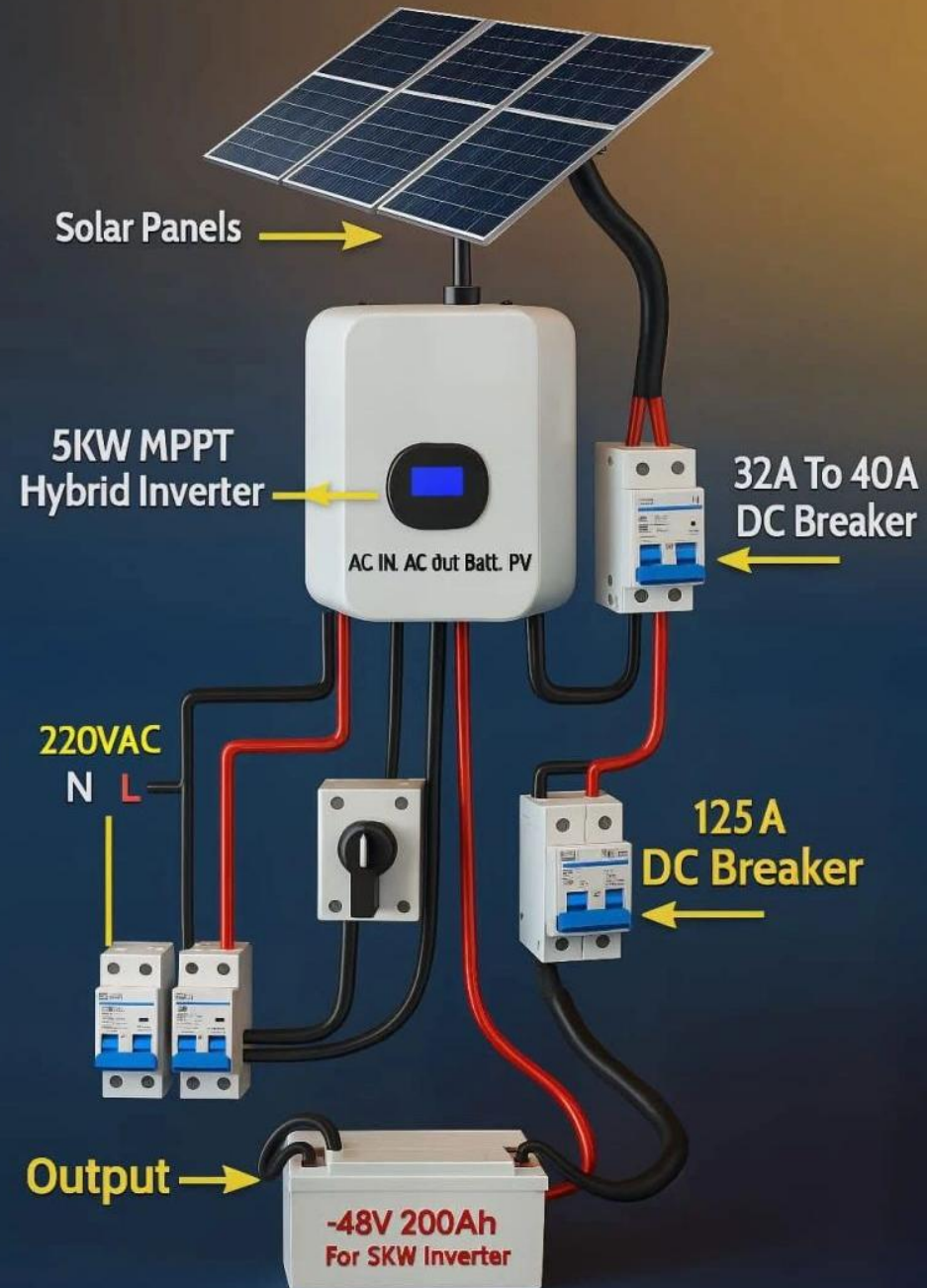
Mysteries: The Solar Inverter That Wouldn't Sync at Noon

09 April 2026

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Emeritus Professor Akhtar Kalam

EIT EMERITUS PROFESSOR



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- For the Engineering College of Technology (ECT) visit: <https://www.ect.ac.uk/>
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Introduction – Presenter



Emeritus Professor Akhtar Kalam

Emeritus Professor at Victoria University and EIT.

Academic Director and Chair of the Academic Board - Texila College Australia.

Director of Al-Kalam Educational Solutions.

Editor-in-Chief of AJEEE

Distinguished Professor/Adjunct Faculty in Australia, India, Malaysia and Oman.

He has published over 610 publications in his area of expertise and has written over 29 books.

Supervised 51 postgraduate research students to graduation, including 39 PhD's and 12 MEngs. Currently, 10 postgraduate research students (four PhD students at VU and six DEng students at EIT) are being supervised.

Public, University, and Motivational Lecturer.

Consultant for the electricity supply industries in Australia and overseas.

Assisted in change management plans for Universities and the higher education sector.

Education

The University of Bath, Bath, UK, D.Eng., Electrical Engineering

The University of Oklahoma, Norman, USA, MS, Electrical Engineering

Aligarh Muslim University, Aligarh, India, BSc. Eng., Electrical Engineering

St Xavier's College, Calcutta, India, Applied Science

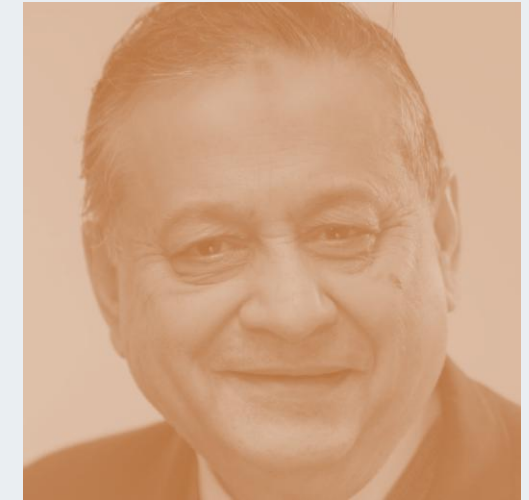
Professional Society Activities

Australian Institute of Energy – Fellow

Engineers Australia – Fellow

The Institution of Engineers and Technology, UK – Fellow.

The Institution of Electrical and Electronic Engineers, USA –Life Senior Member.



“My vision is to provide exciting higher education science and engineering courses, research, consultancy and collaborate in development work of the industry and communities within Australia and beyond.”

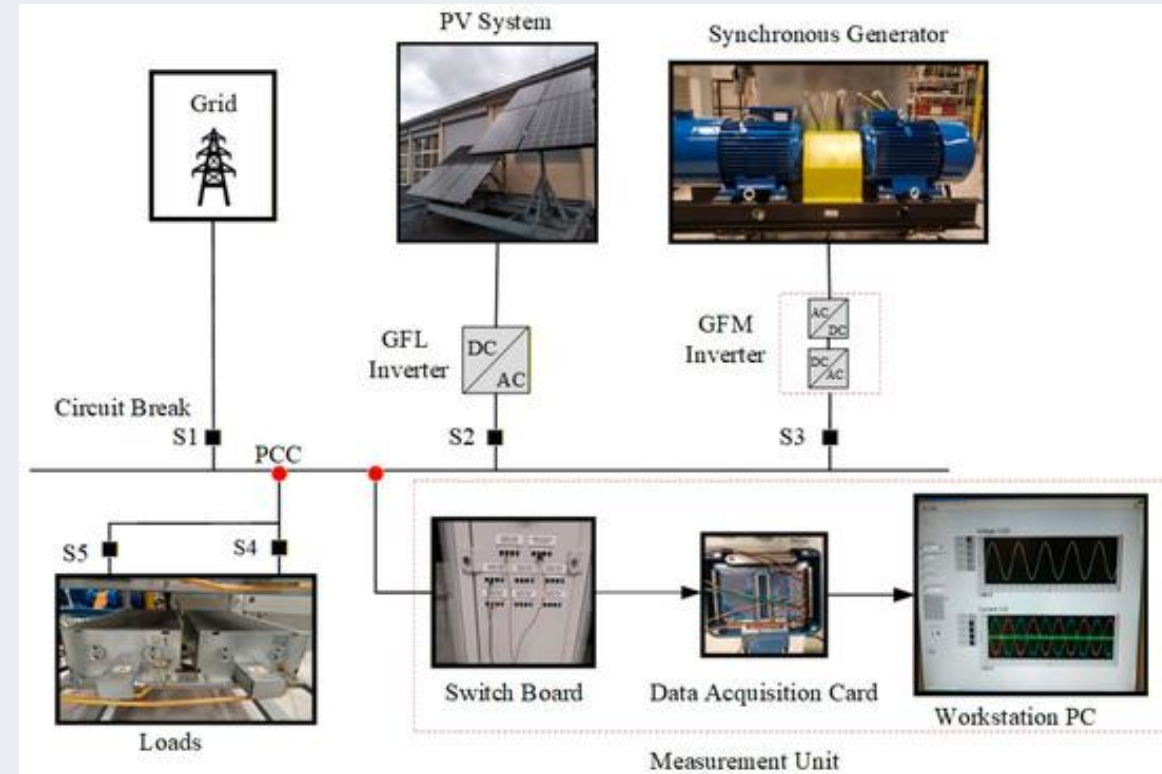
Agenda

1.	Learning Objectives
2.	Overview of the problem
3.	Hypothesis
4.	Identifying the Root Cause
5.	The Solution
6.	Key Takeaways
7.	Q&A



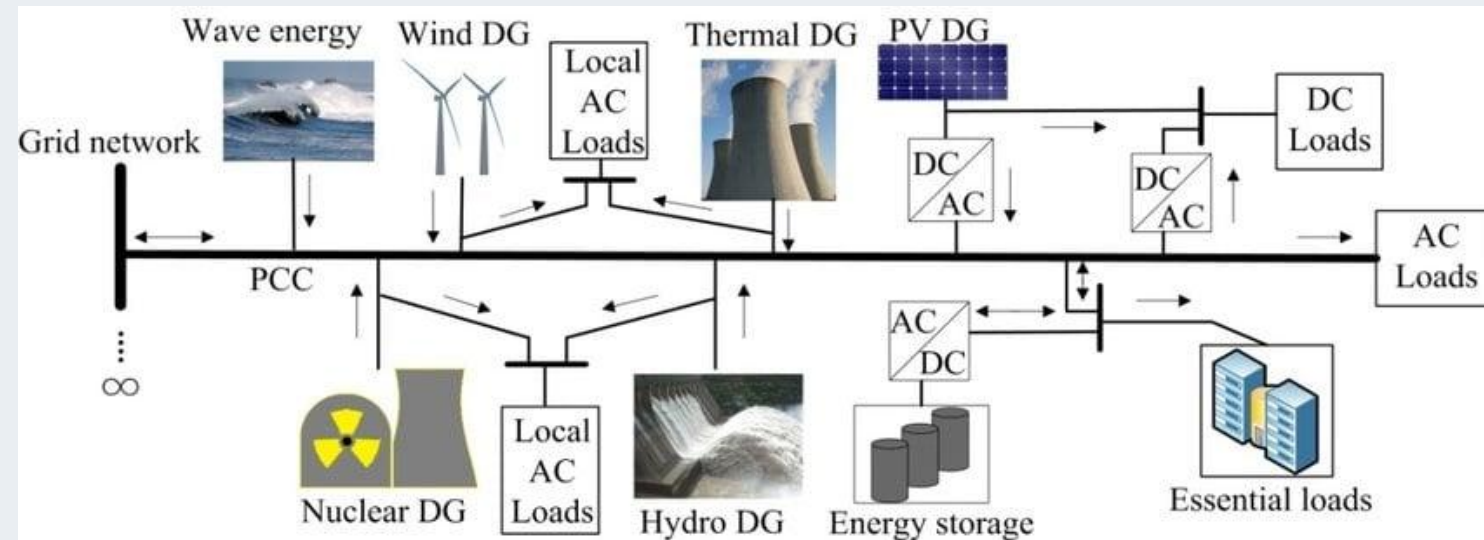
Learning Objectives

- Understand inverter-grid synchronisation principles
- Analyse the abnormal field behaviour
- Apply systematic troubleshooting methods
- Identify the hidden system interactions



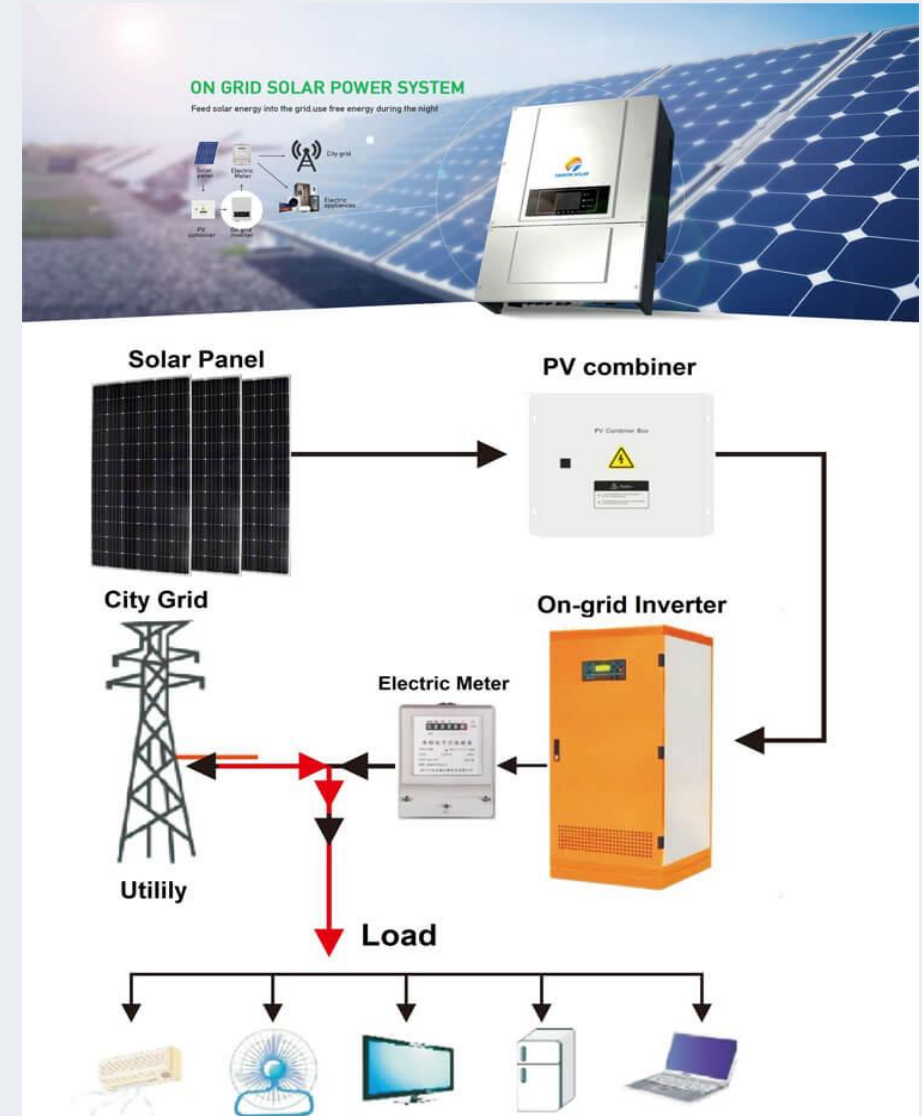
Why “Engineering Mysteries”?

- Systems behave differently in real environments
- Multiple interacting variables
- Hidden faults vs visible symptoms
- Importance of engineering intuition



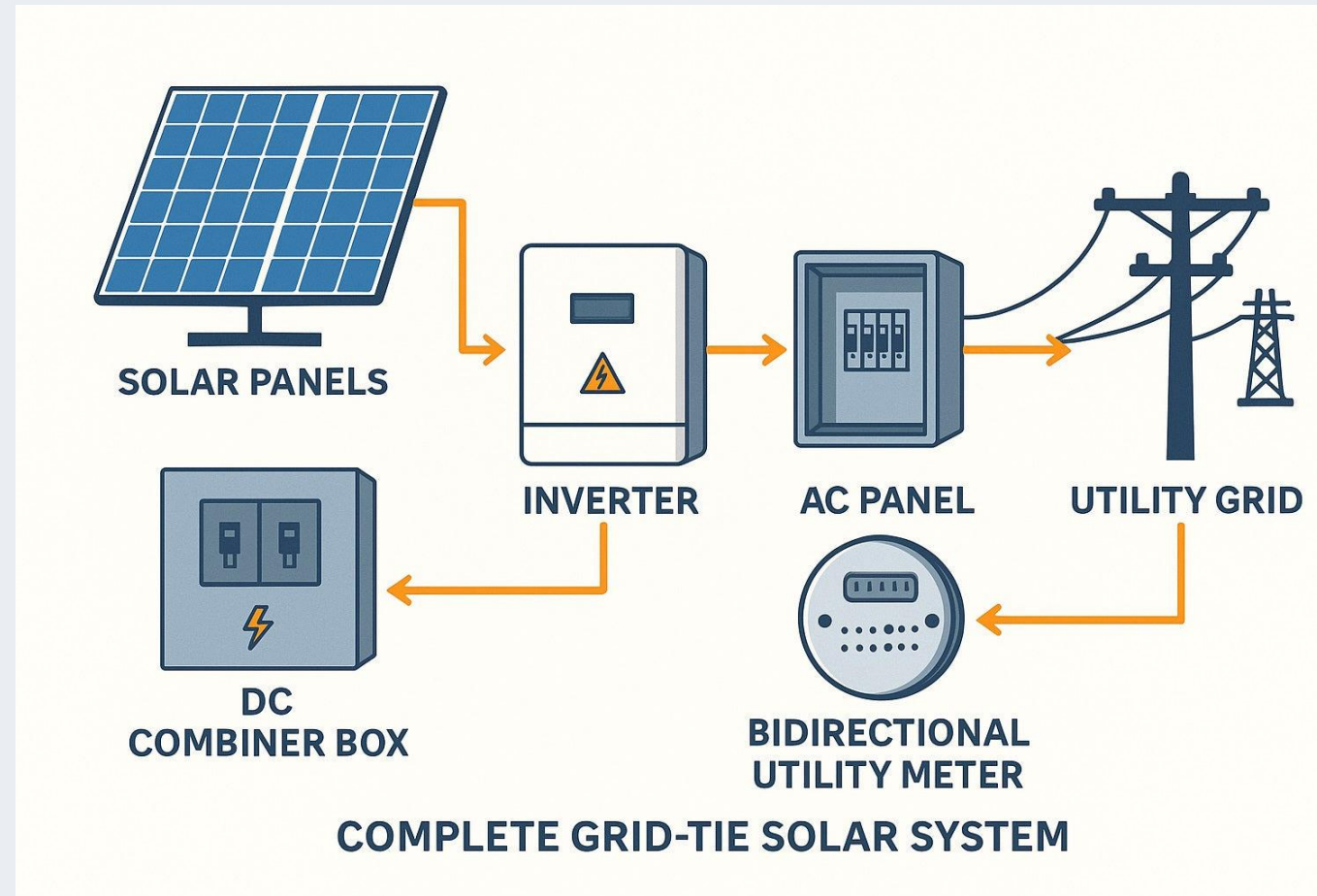
Case Introduction

- Grid-connected solar PV system
- 100 kW commercial installation
- Issue: Inverter fails to synchronise
- Occurs only around noon



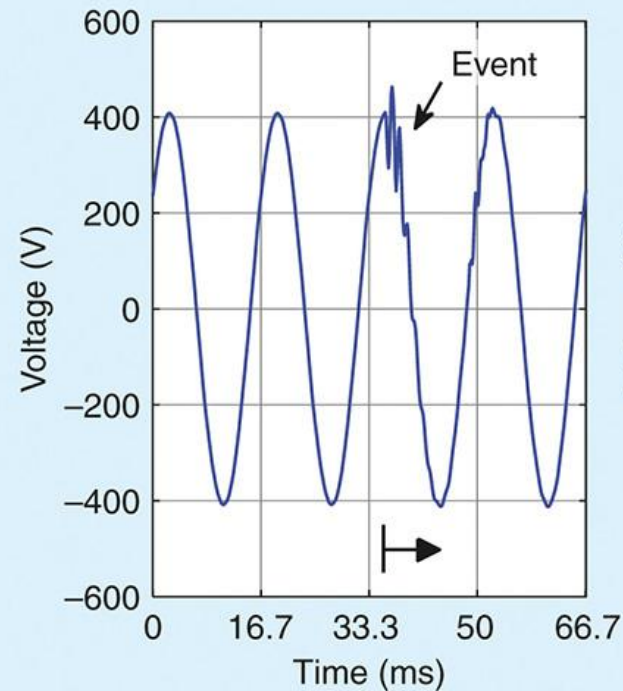
System Overview

- PV array (DC source)
- Grid-tied inverter
- Utility grid connection
- Protection and monitoring

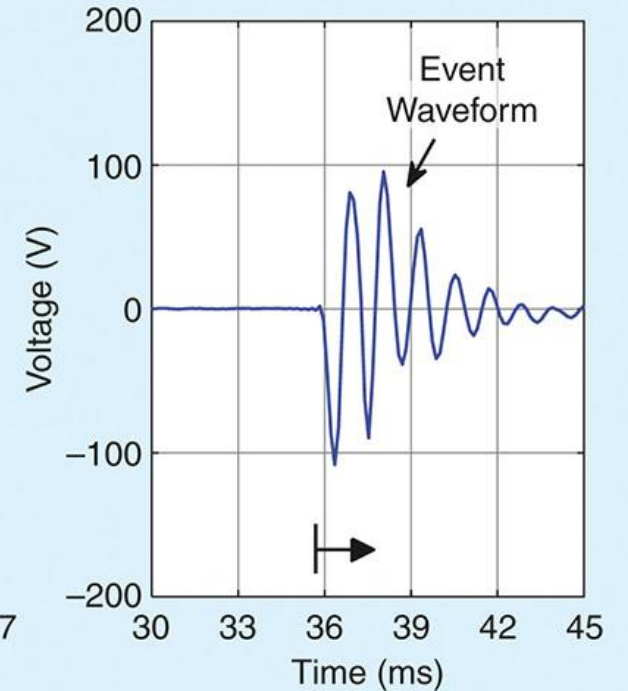


Normal Synchronisation Process

- Voltage matching
- Frequency matching
- Phase alignment
- Anti-islanding checks



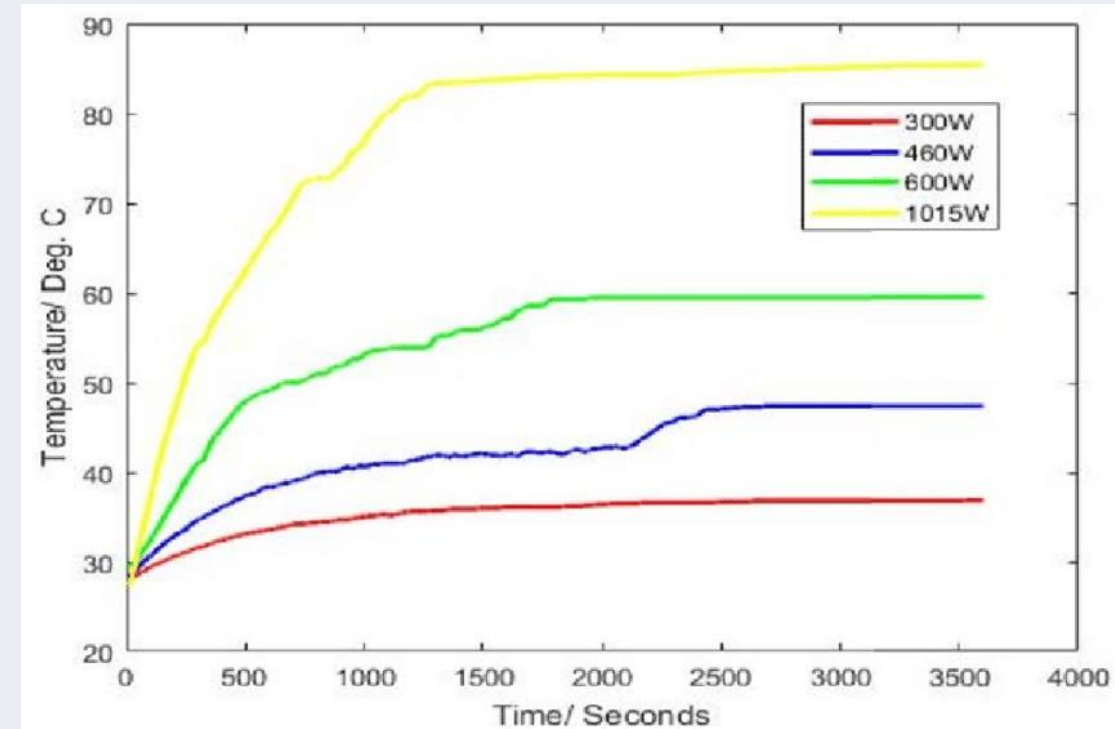
(a)



(b)

Observed Problem

- Inverter runs fine in morning
- Trips or fails to sync at noon
- Resumes normal operation later
- No permanent fault recorded



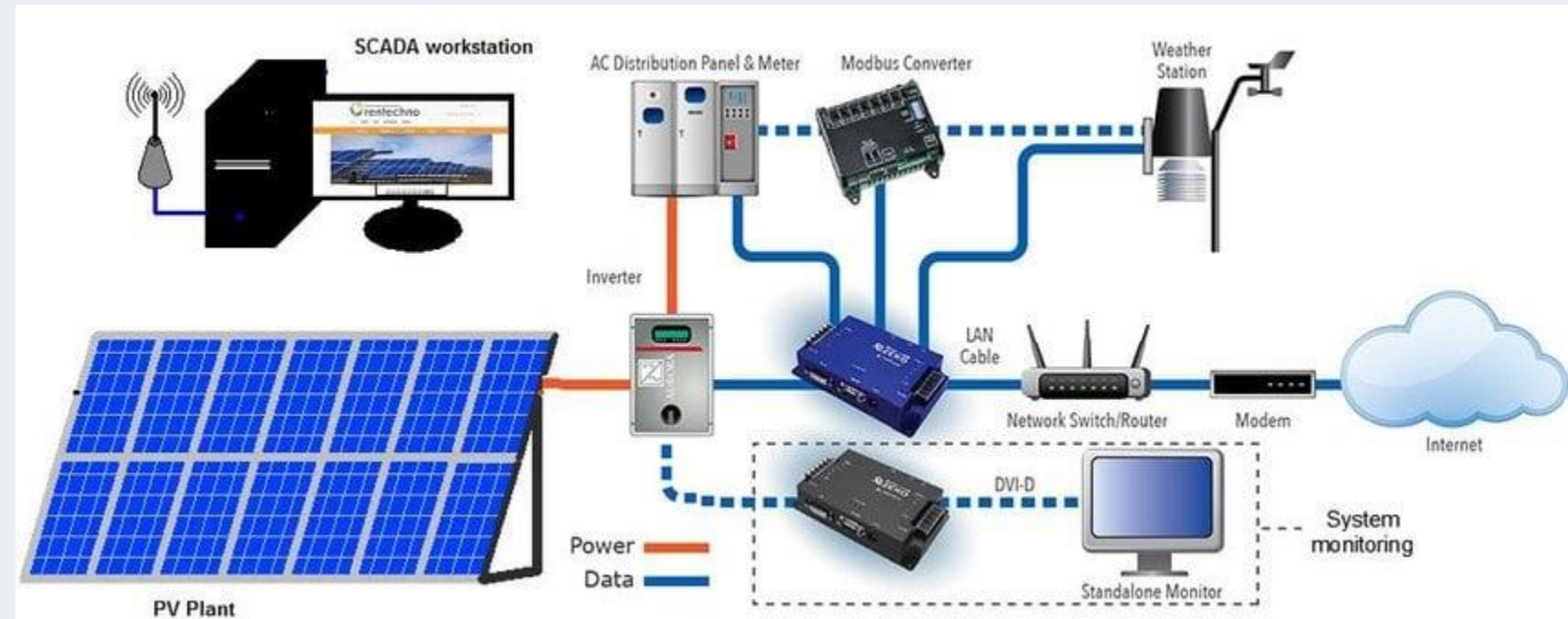
Initial Hypotheses

- Overvoltage
- Overtemperature
- Grid instability
- Protection malfunction



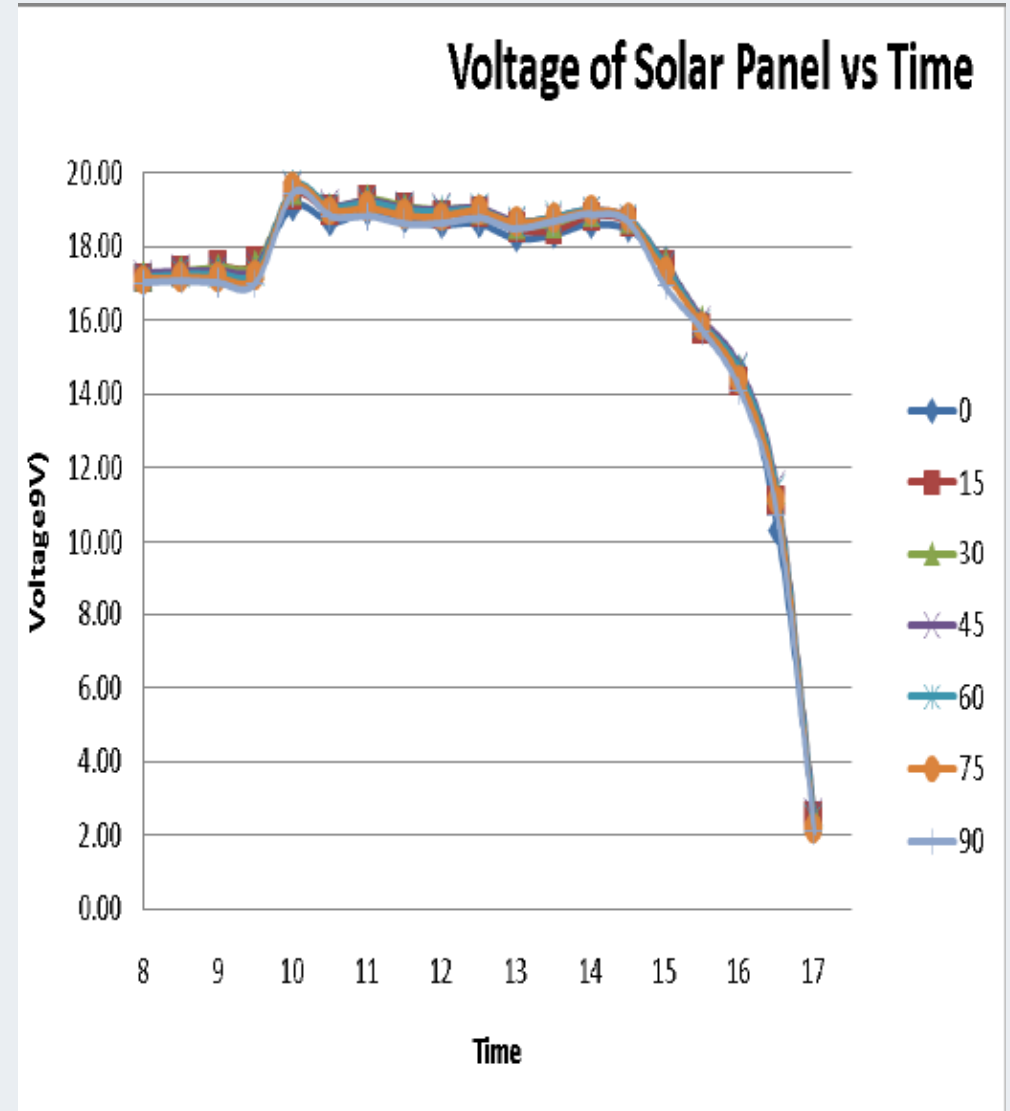
Data Collection

- Voltage logs
- Frequency logs
- Temperature readings
- Event logs



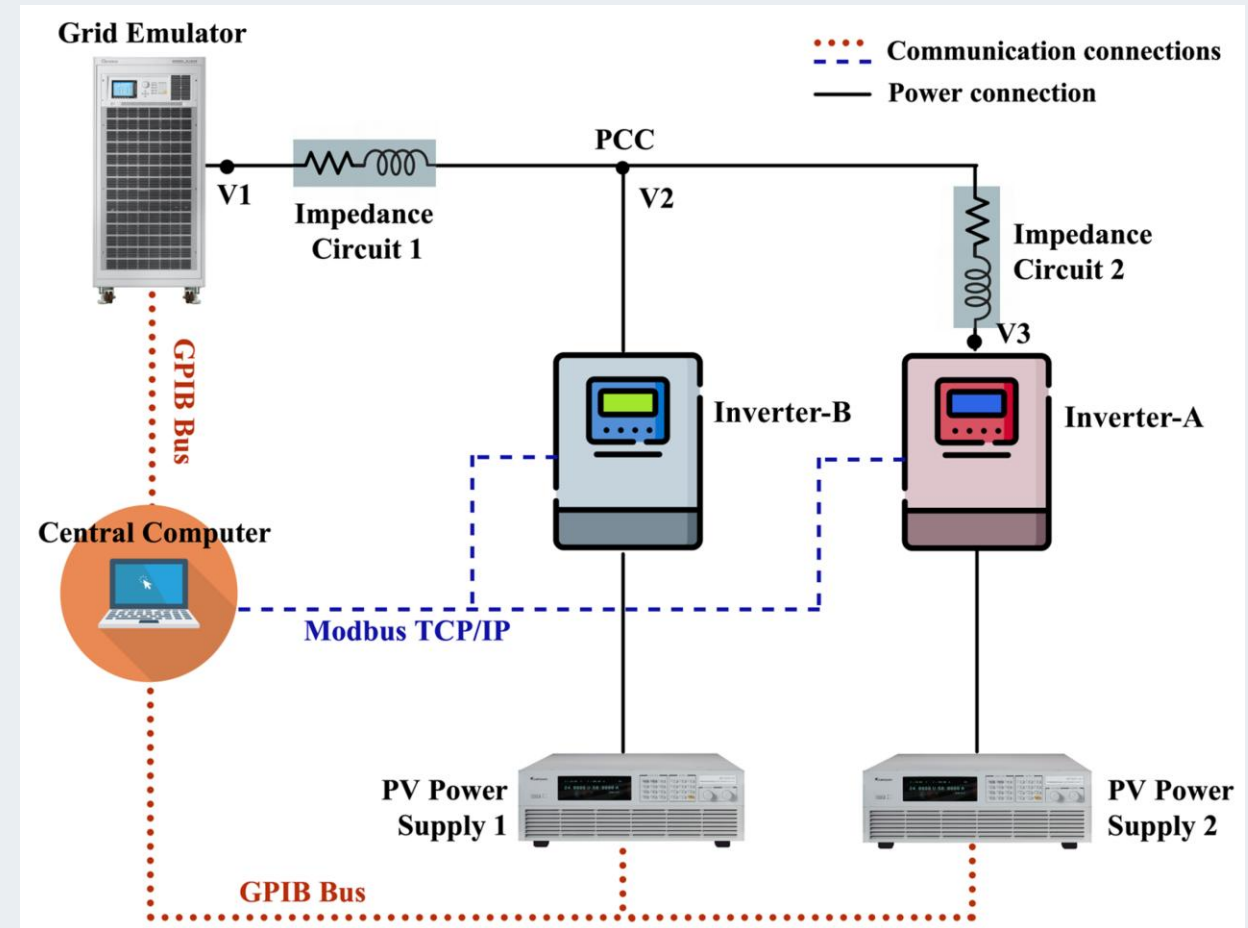
Voltage Profile Analysis

- Voltage rises near noon
- Peak solar generation
- Possible voltage limit breach



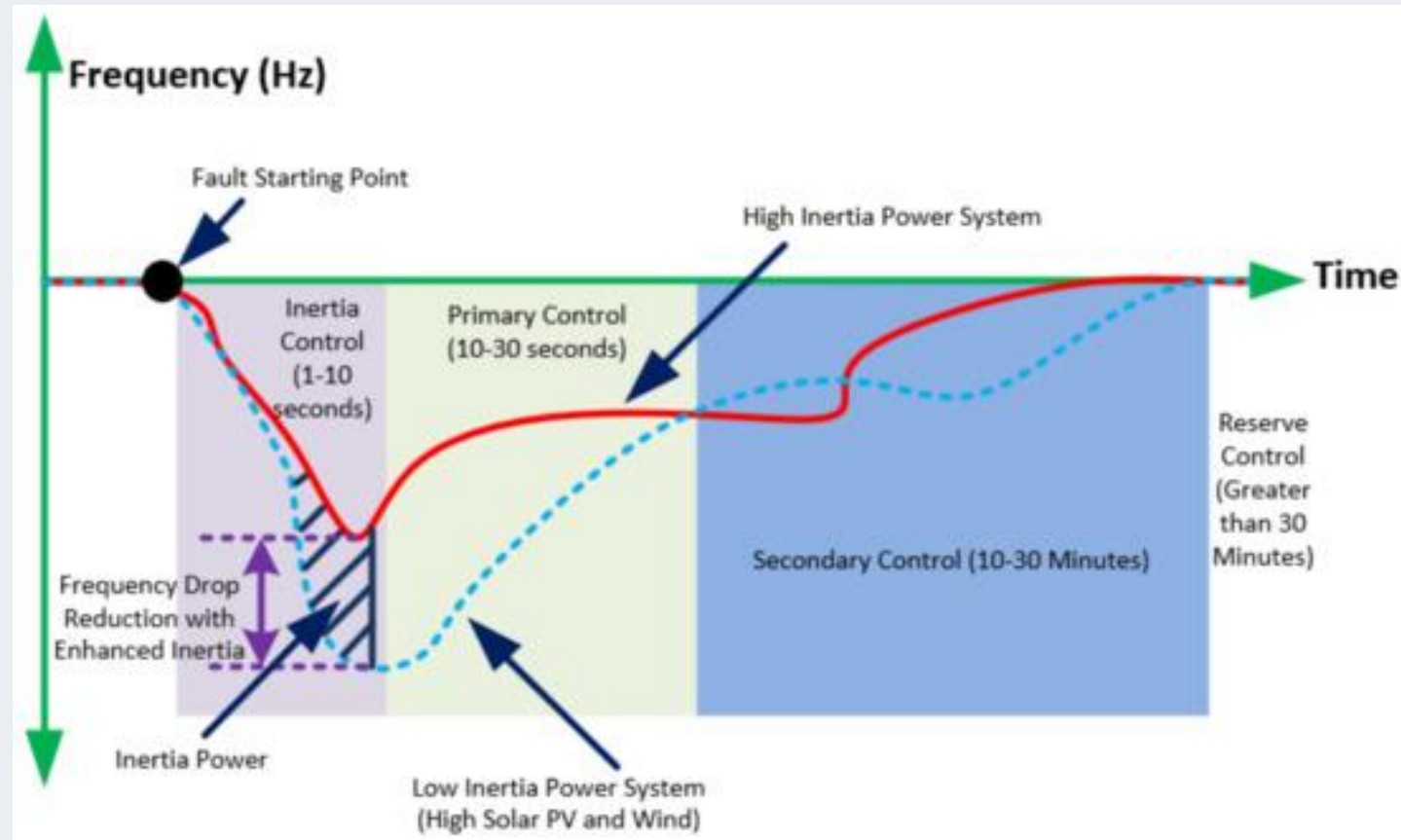
Grid Voltage Rise Phenomenon

- High PV injection → voltage increase
- Weak grid → larger voltage rise
- Impedance effects



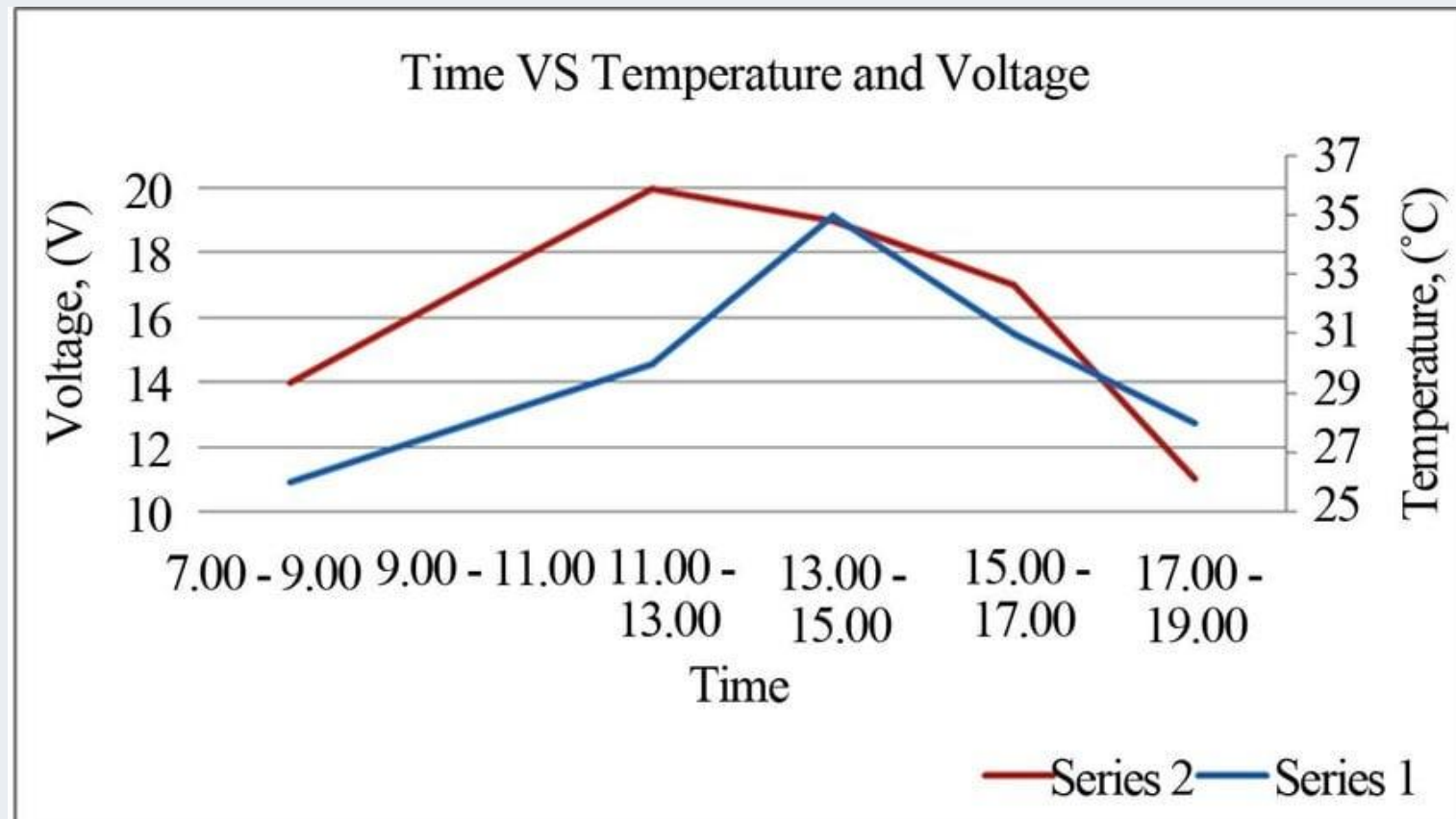
Frequency Check

- Grid frequency stable
- No abnormal deviation
- Frequency ruled out



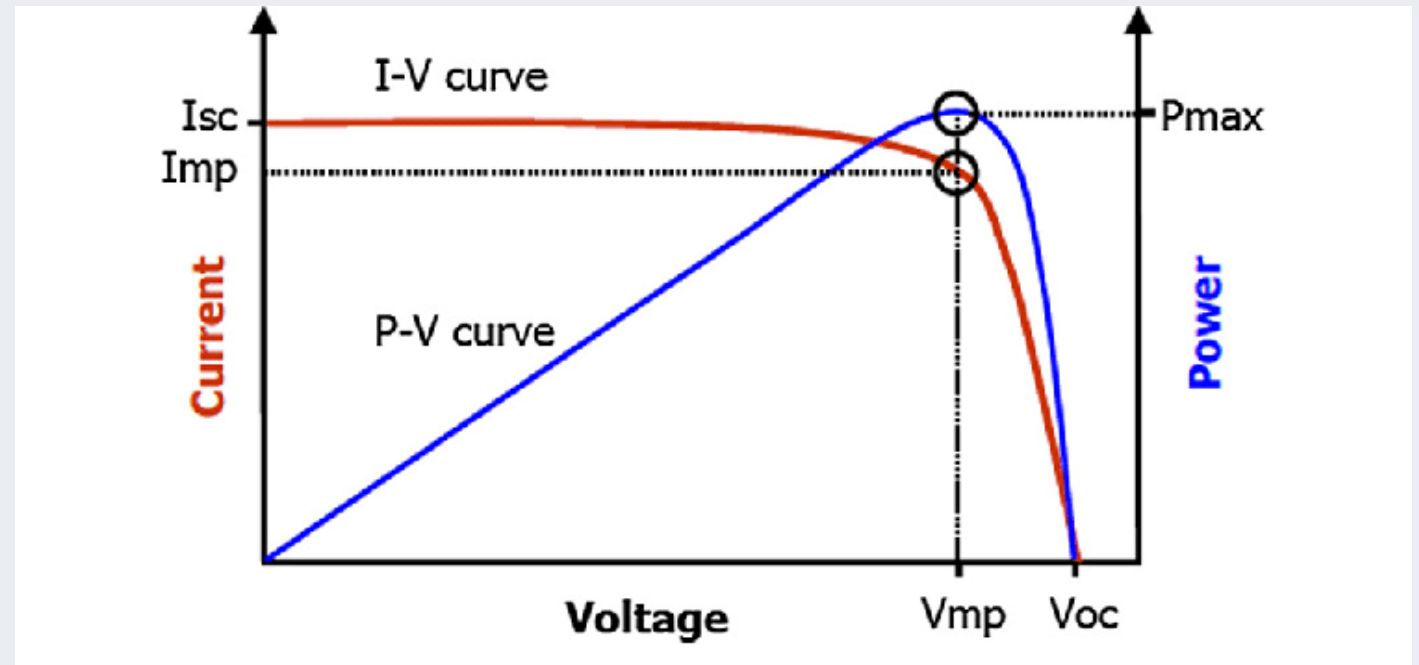
Temperature Investigation

- Ambient temperature peaks at noon
- Inverter thermal derating
- Cooling performance



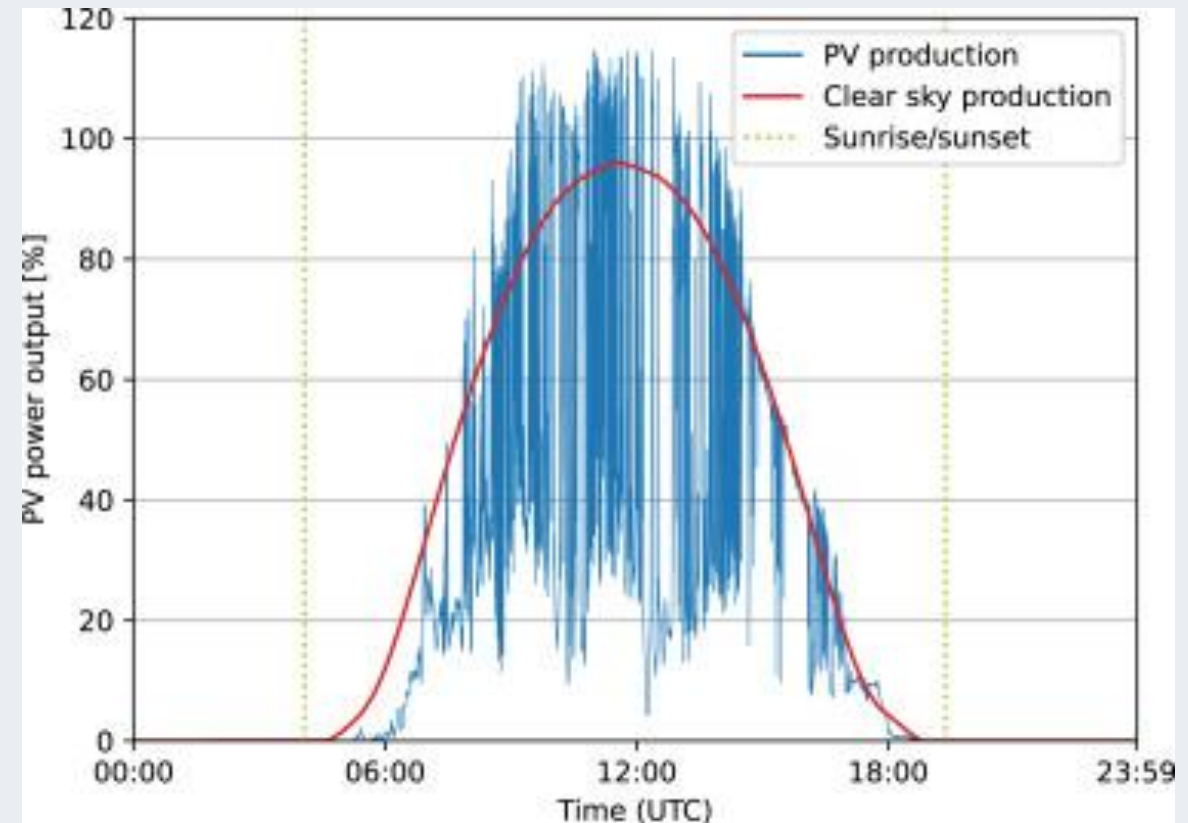
Protection Settings Review

- Overvoltage thresholds
- Anti-islanding settings
- Grid compliance limits



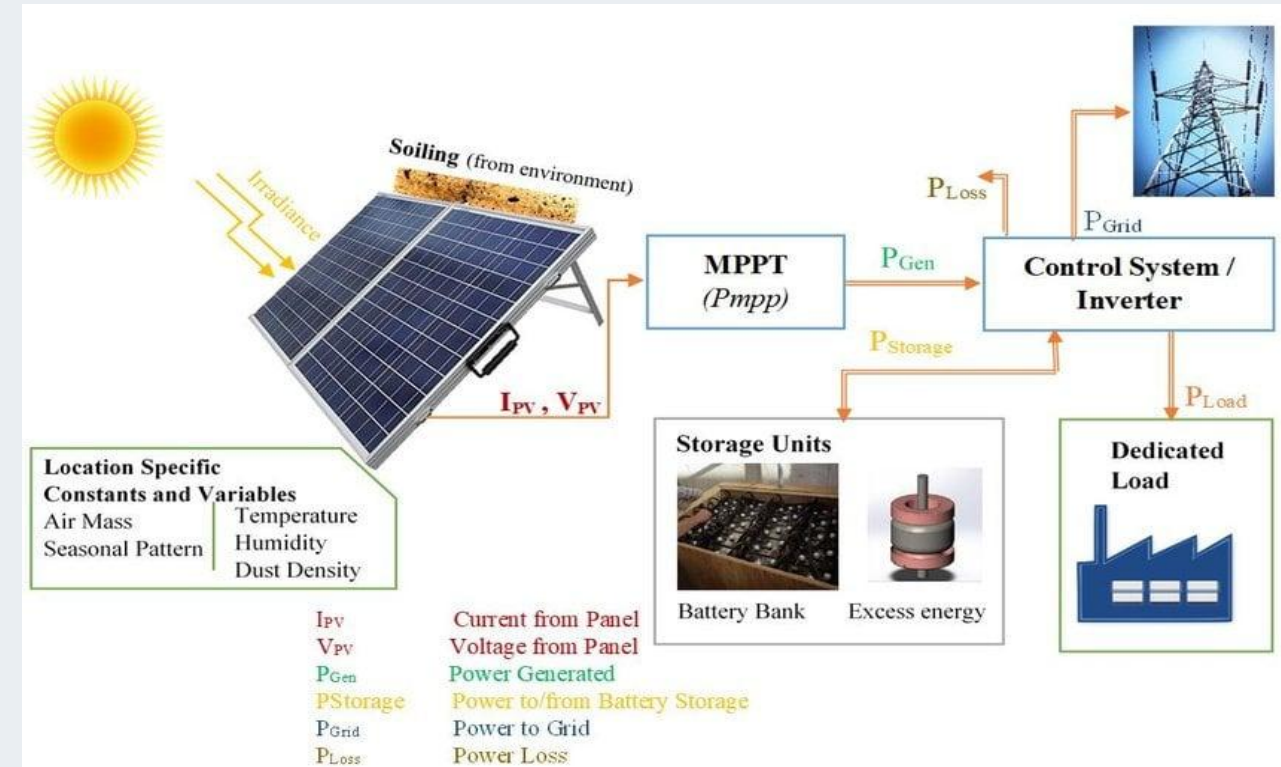
Hidden Clue

- Voltage spikes correlate with solar peak
- Occurs only under high irradiance
- Not a hardware fault



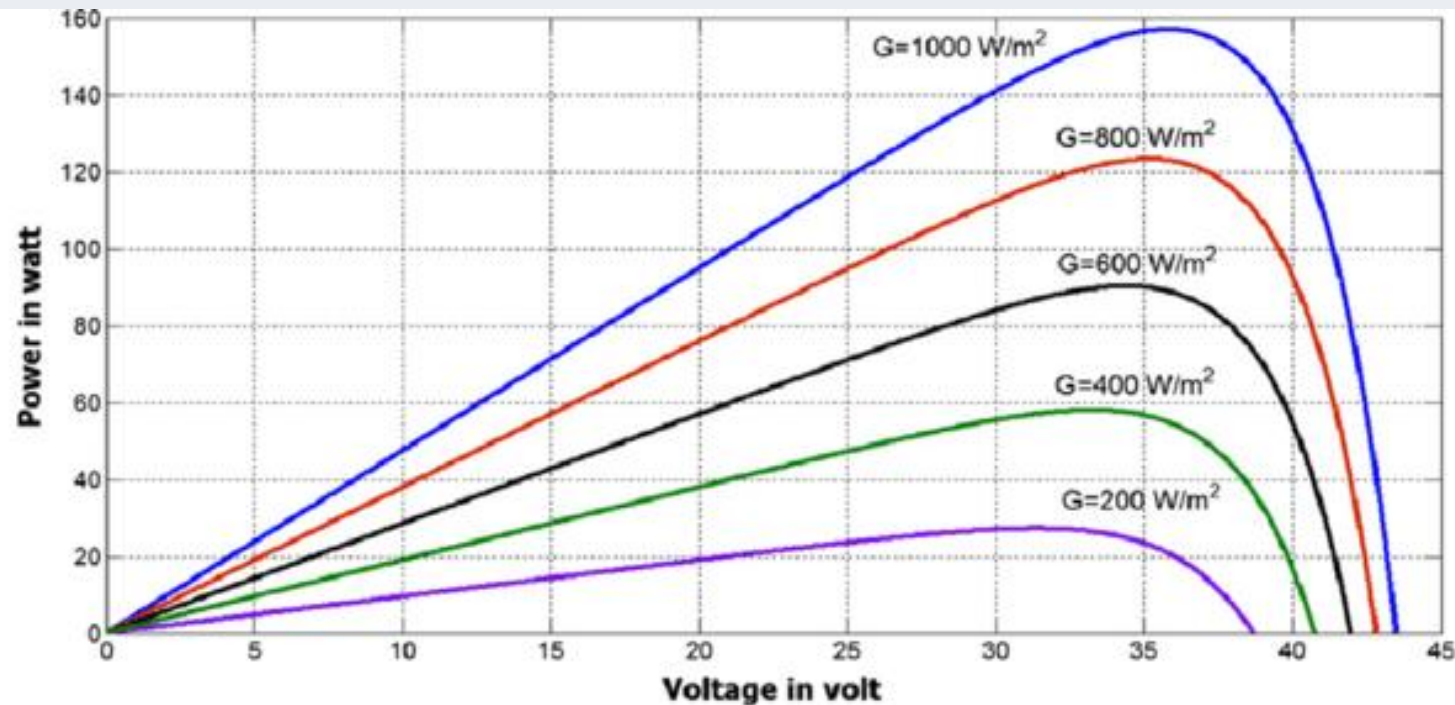
Root Cause Identified

- Local grid voltage exceeds inverter sync limits
- The inverter disconnects for protection
- Weak feeder + high PV penetration



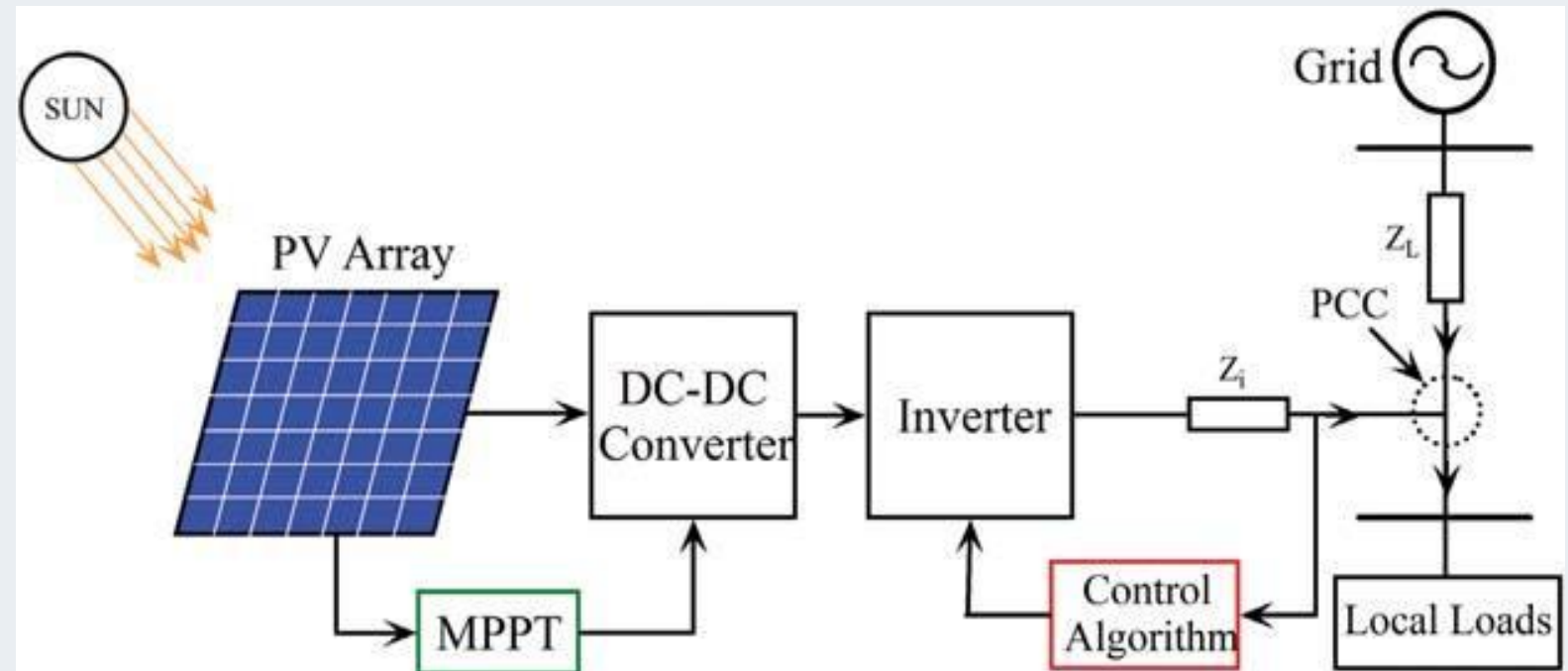
Why Only at Noon?

- Maximum solar generation
- Minimum local load
- Peak voltage rise condition



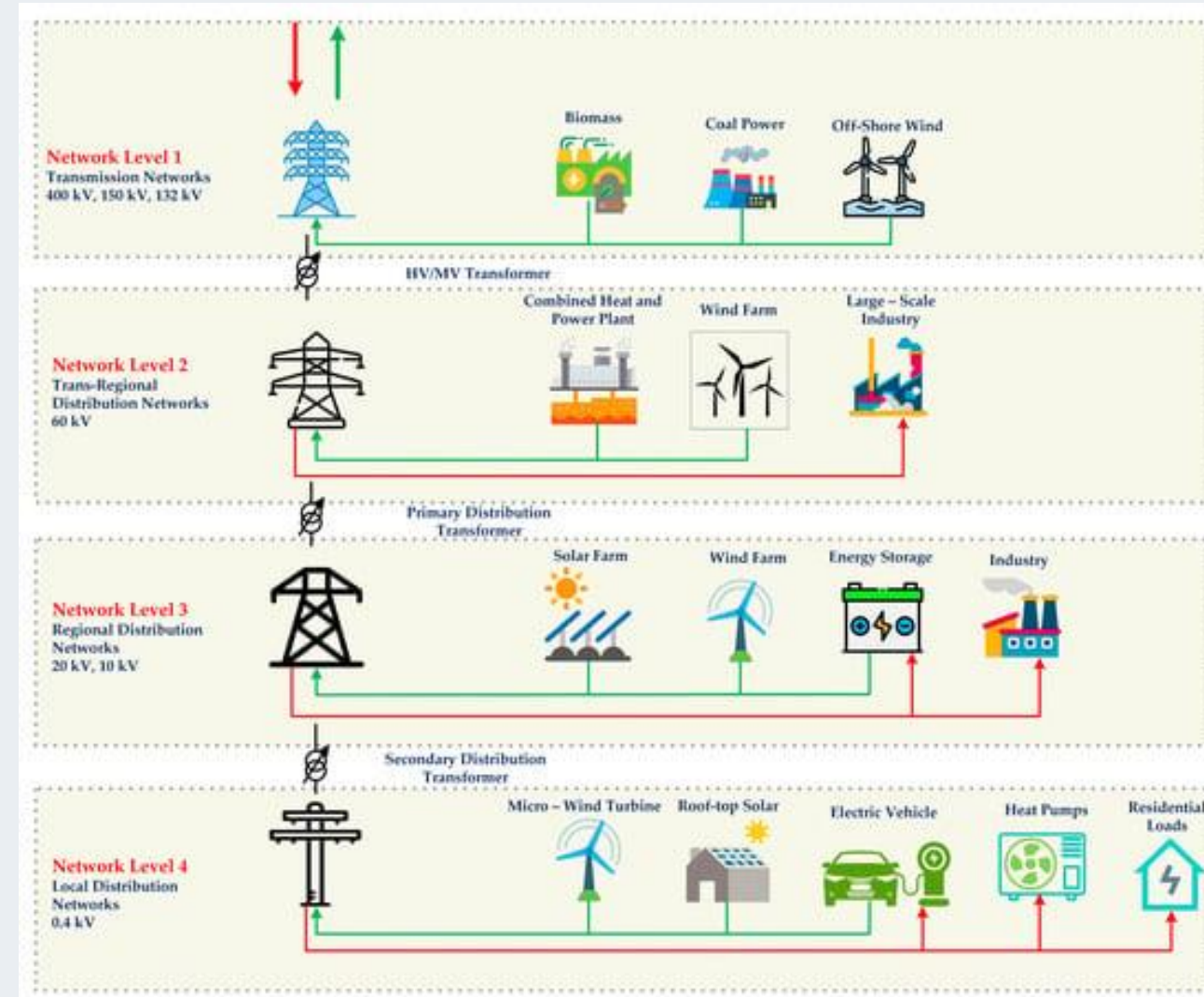
Engineering Insight

- System-level issue, not component failure
- Interaction between generation and grid
- Importance of the network studies



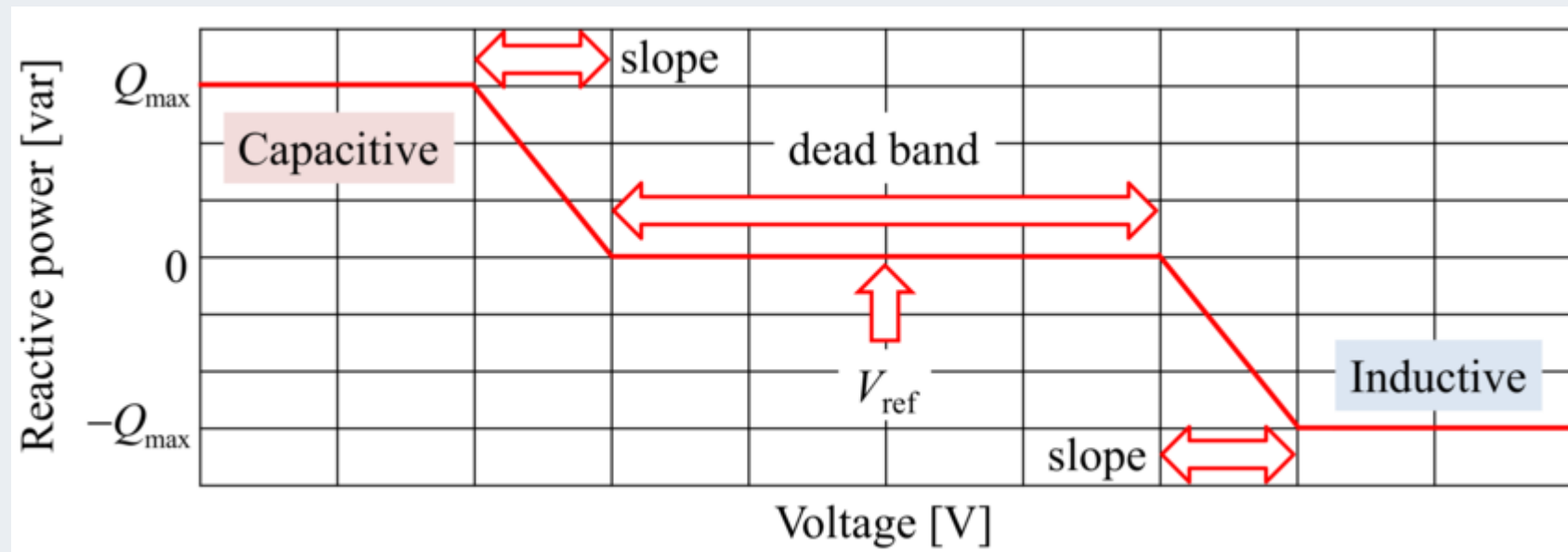
Possible Solutions

- Adjust inverter voltage limits
- Install voltage regulation
- Add energy storage
- Network reinforcement



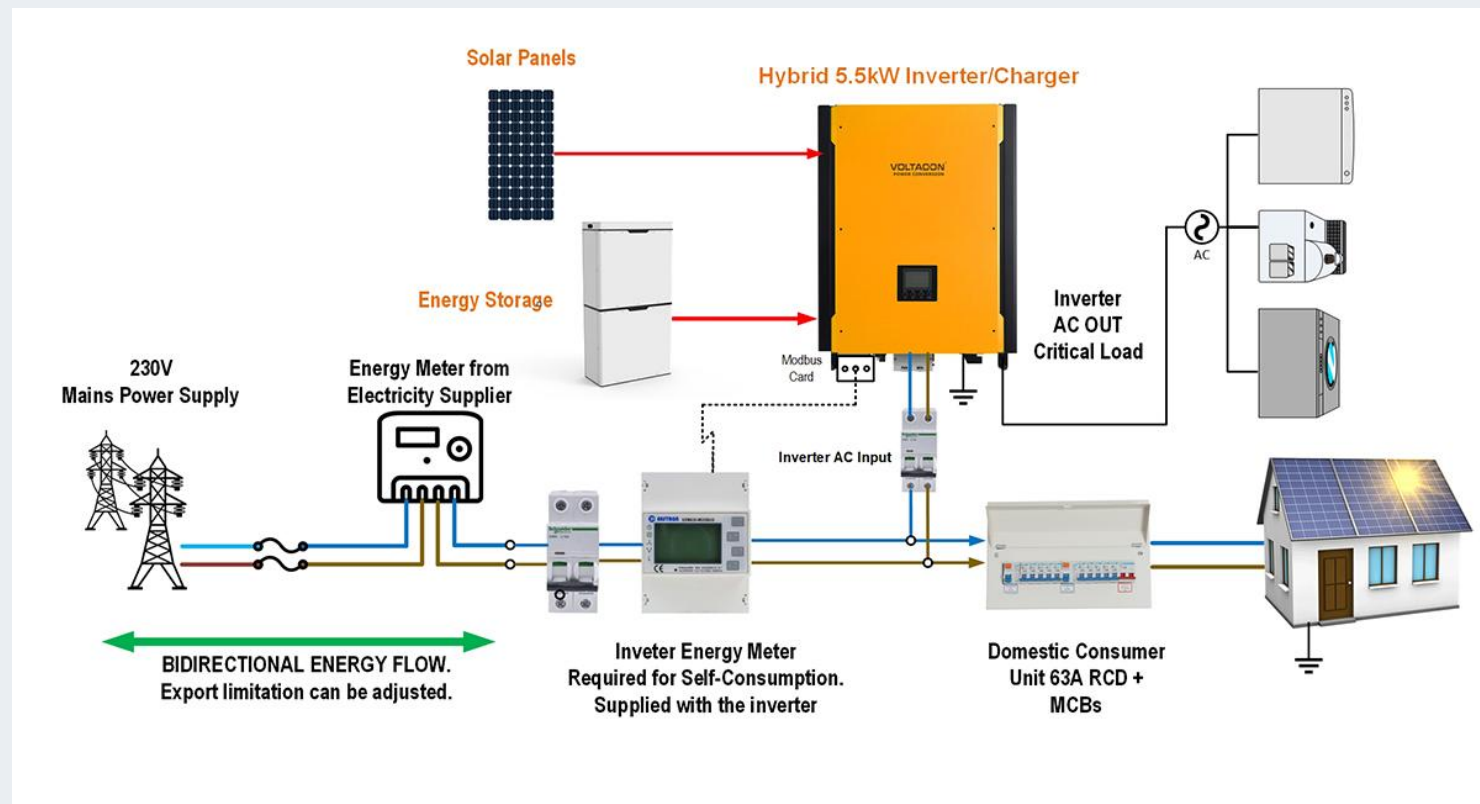
Solution 1: Volt-VAR Control

- Reactive power support
- Voltage regulation
- Smart inverter functionality



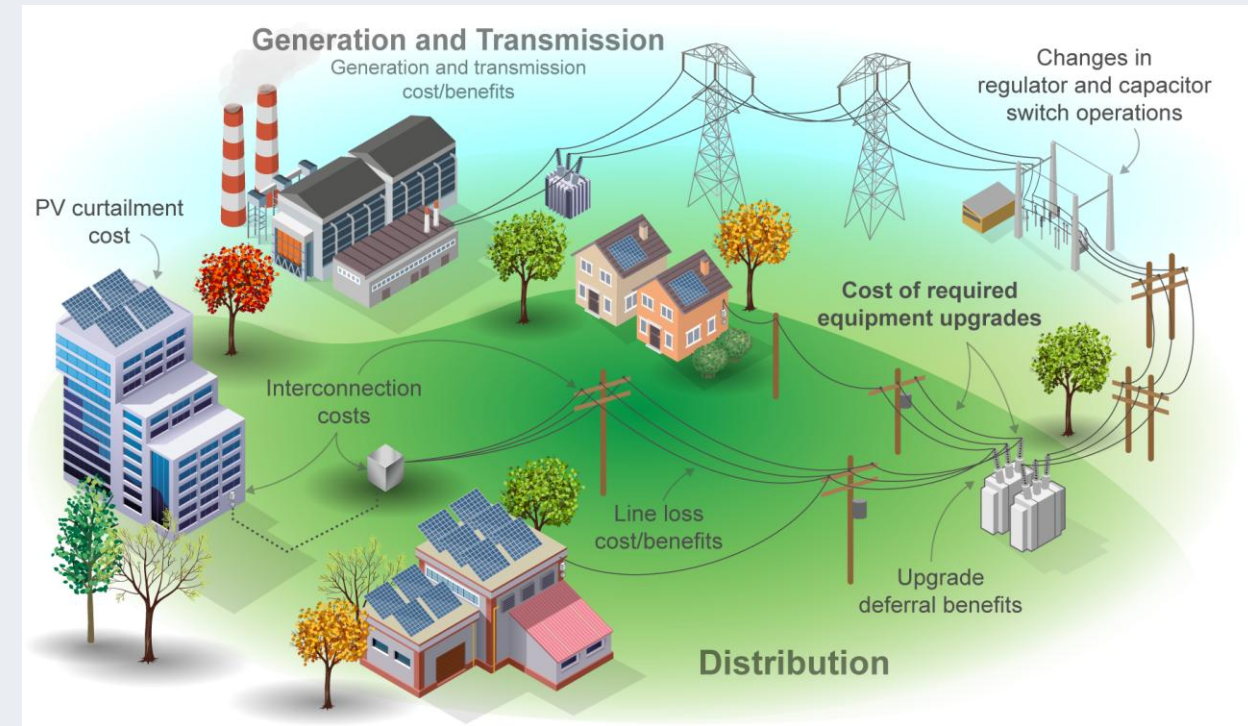
Solution 2: Battery Storage

- Absorb excess generation
- Reduce export spikes
- Improve stability



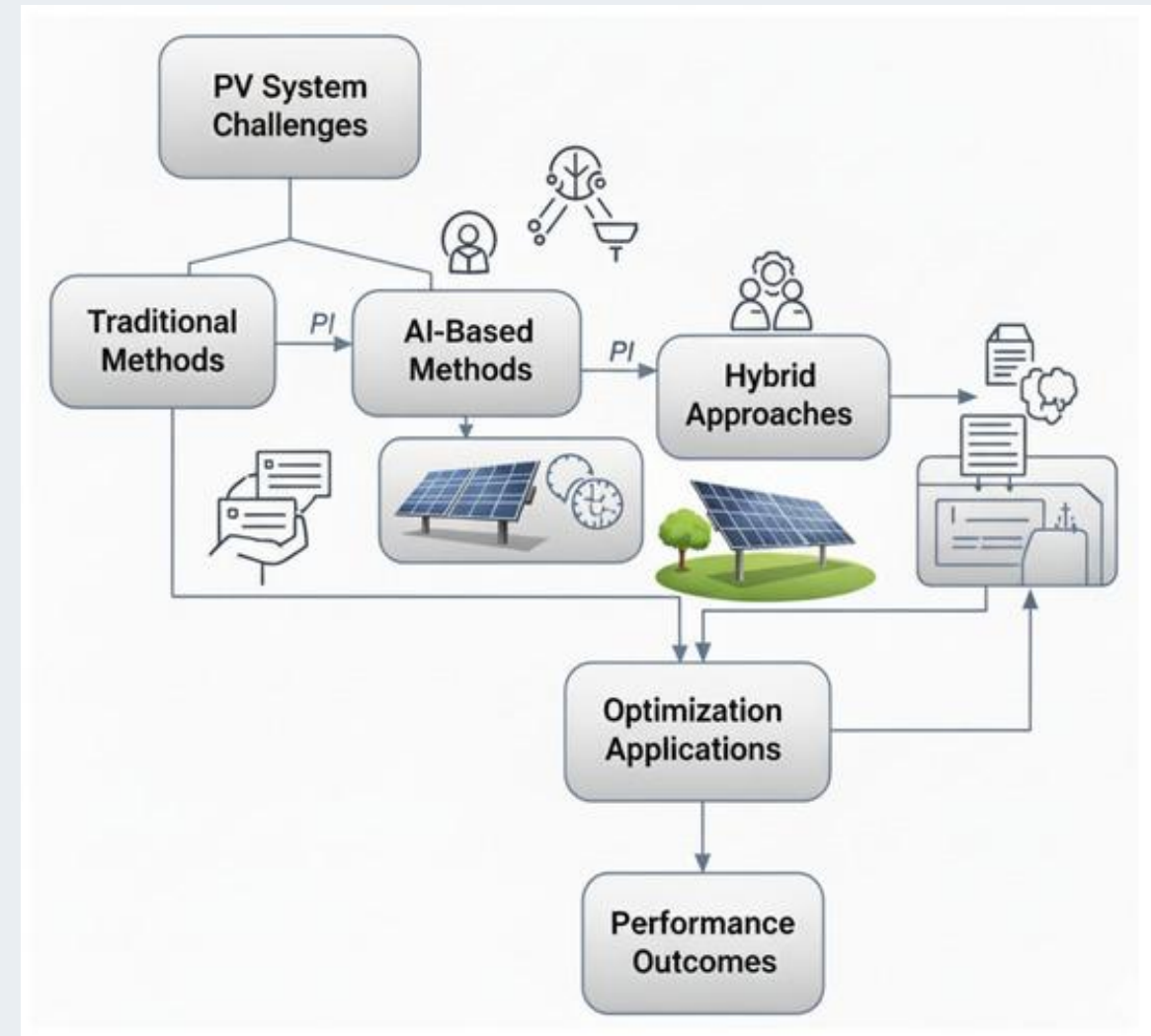
Solution 3: Grid Upgrade

- Reduce line impedance
- Improve voltage stability
- Expensive but effective



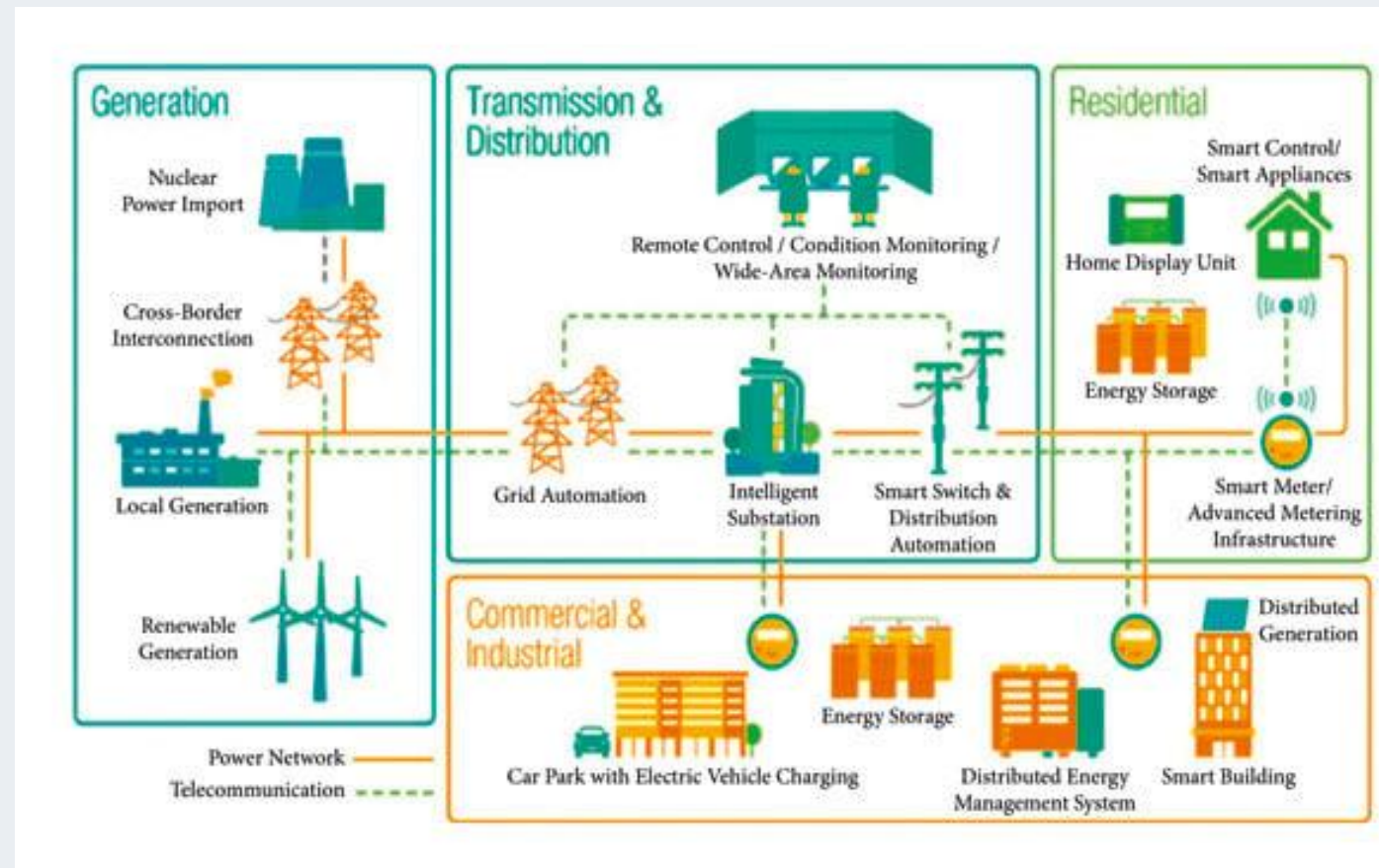
Lessons Learned

- Always consider the system interactions
- Time-dependent faults are critical clues
- Data logging is essential



Broader Implications

- Increasing renewable penetration
- Grid stability challenges
- Need for smarter grids



Discussion Questions

- How would you diagnose faster?
- What alternative solutions exist?
- Could this be predicted in design?



Extension Case Ideas

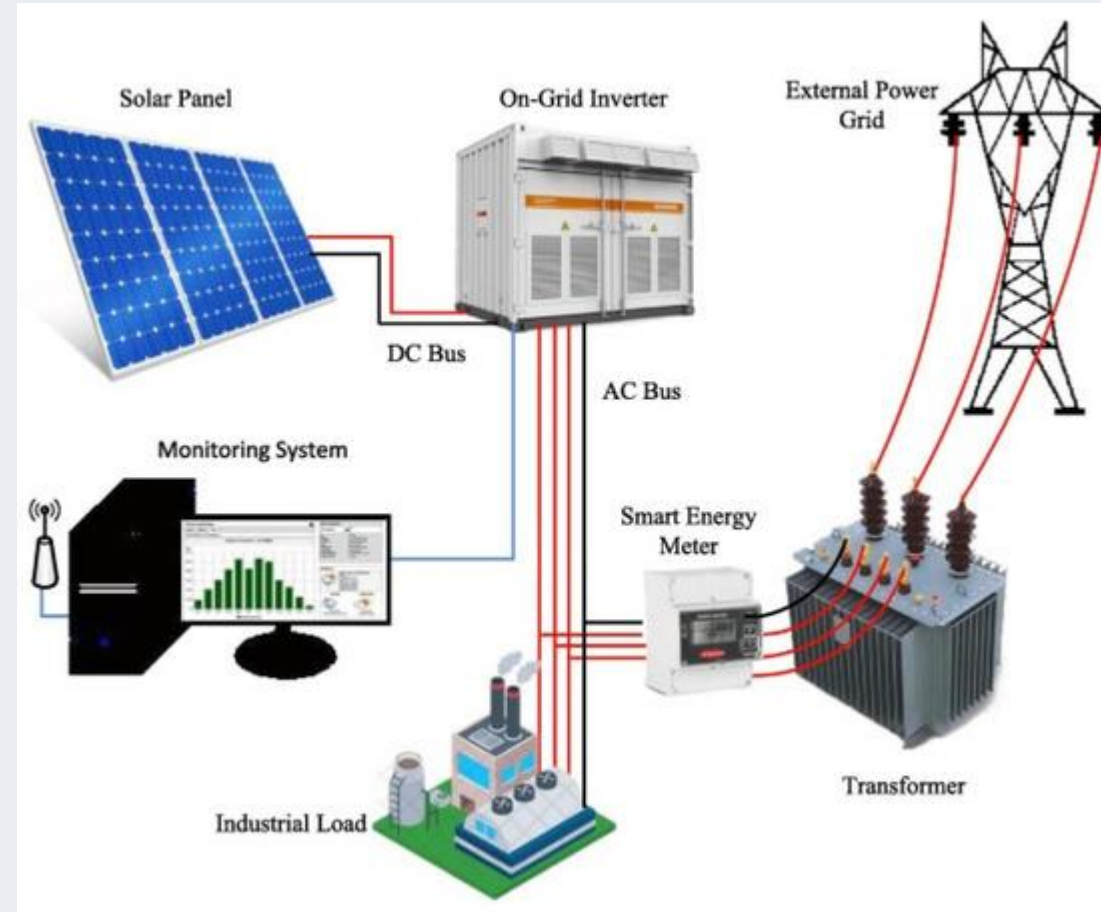
- Cable overheating at partial load
- Phantom neutral voltage issues
- UPS failure during blackout

HEAT DOES NOT INCREASE SOLAR PRODUCTION



Key Takeaways

- Real systems are non-ideal
- Data + reasoning = diagnosis
- Engineering judgement is essential



Closing

- Questions & Discussion
- Thank You



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14 May – The Disappearing Neutrals in a TN-C-S Network

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18 June - The Phantom Neutral - Why the Feeder Voltage Floated Overnight?

9 July – The Relay That Refused to See a Short

16 July - The Capacitor Bank That Blew Itself Up Quietly

13 August – The Motor That Wouldn't Start - Unless It Was Empty

20 August - The Neon Sign That Pulsed with Passing Trucks

10 September – The Battery Bank That Lost Capacity Overnight

17 September - The Streetlight That Kept Turning on at Noon

12 November – The Transformer That Changed Tap Position by Itself

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10 December – The PLC That Spoke Back - A Control Loop with a Mind of Its Own

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27 January - The Induced Voltage That Woke the Cattle



Thank You!

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52888WA Advanced Diploma of Applied Electrical Engineering (Power Industry)	5 May 2026
Professional Certificate of Competency in Electrical Power System Fundamentals for Non Electrical Engineers	5 May 2026
52910WA Graduate Certificate in Hydrogen Engineering and Management	5 May 2026
Professional Certificate of Competency in Substation Design (Main Equipment)	12 May 2026
Professional Certificate of Competency in Battery Energy Storage and Applications	12 May 2026
Professional Certificate in Essential Practices for Electrical Safety, Earthing, and Lightning Protection	18 May 2026
UET60222 Advanced Diploma of ESI - Power Systems (Australia and New Zealand Only)	2 June 2026
Professional Certificate of Competency in Power Distribution	9 June 2026
Online - Master of Engineering (Electrical Systems)	29 June 2026
Graduate Certificate in Power System Analysis and Design	29 June 2026

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Engineering College of Technology (ECT) <i>UK qualifications</i>	Start Date
Bachelor of Engineering (Honours) in Industrial Automation	21 September 2026
Bachelor of Engineering (Honours) in Electrical Engineering	21 September 2026
Master of Science (Power System Analysis and Renewable Integration)	1 June 2026
Master of Science (Industrial Automation and Instrumentation Control)	1 June 2026

Engineering College of Science and Technology (ECST) <i>South African accredited qualification & ECSA-endorsed</i>	Start Date
Bachelor of Engineering Technology in Electrical Engineering	3 August 2026

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Q&A



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Head Office

6 & 8 Thelma Street, West Perth,
Perth, WA 6005



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Website

www.ect.ac.uk



Head Office

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United Kingdom



Phone

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Head Office

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