



TECHNICAL SEMINAR

Renewable Energy Systems

Solar, wind and the path to clean power

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GUIDE
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Agenda

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OVERVIEW

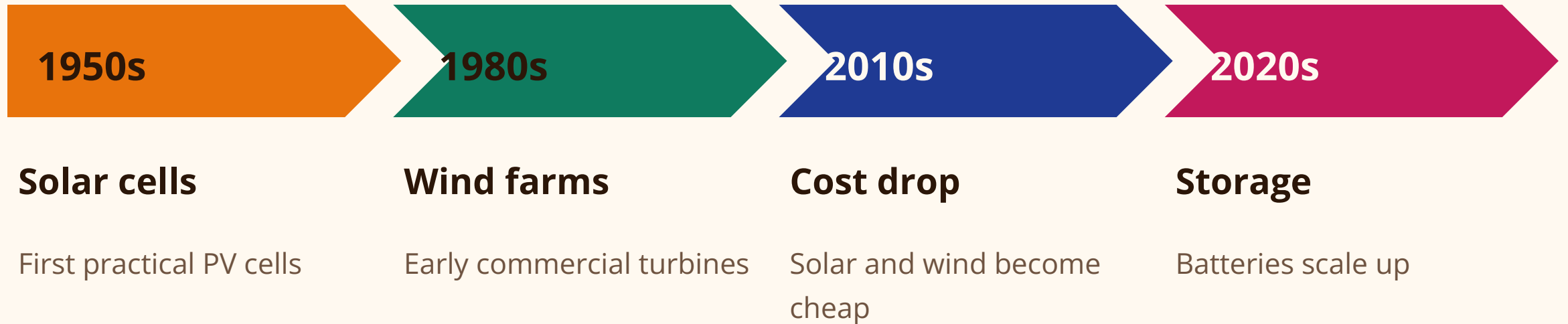
Introduction

- Renewable energy comes from sources that refill naturally
- Solar and wind are now among the cheapest power sources
- Storage and smart grids handle their variability
- Clean energy is central to climate goals



Image

Evolution



02

CORE CONCEPTS

Key concepts



Photovoltaics

Solar cells turn light directly into electricity.



Wind turbines

Blades turn a generator using wind energy.



Energy storage

Batteries and pumped hydro balance supply.

How it works



Generate

Solar panels and turbines



Convert

Inverters to grid power



Store

Batteries for later use



Distribute

Smart grid delivers power

Architecture

Generation, storage and a smart grid.

Variable renewable output is smoothed by forecasting, battery storage and flexible demand, while a digital grid balances supply and demand every second.



Architecture diagram

Applications



Image 1

Rooftop solar

Homes and offices cut bills.



Image 2

Solar parks

Large plants for utilities.



Image 3

Microgrids

Power for remote villages.

03

CHALLENGES

Advantages and limitations

Advantages

- ✓ No fuel cost
- ✓ Low emissions
- ✓ Energy independence
- ✓ Creates local jobs

Limitations

- Weather dependent
- Needs storage
- Land use
- Grid upgrades required

Open challenges



Variability

Sun and wind change.



Storage cost

Batteries still costly.



Grid

Transmission must expand.

04

FUTURE

**Cheaper storage will make
round-the-clock clean power
common.**

Looking ahead

References

- [1] Survey paper on the topic, IEEE Access, 2024.
- [2] Textbook chapter covering fundamentals, 2023.
- [3] Recent conference paper on applications, 2025.
- [4] Industry white paper (generic reference).



Questions?

Thank you for listening.