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India Smart Grid Forum

India SMART UTILITY Week 2024

Supporting Ministries

Session : Virtual Power Plant & Power System Flexibility

Presented By

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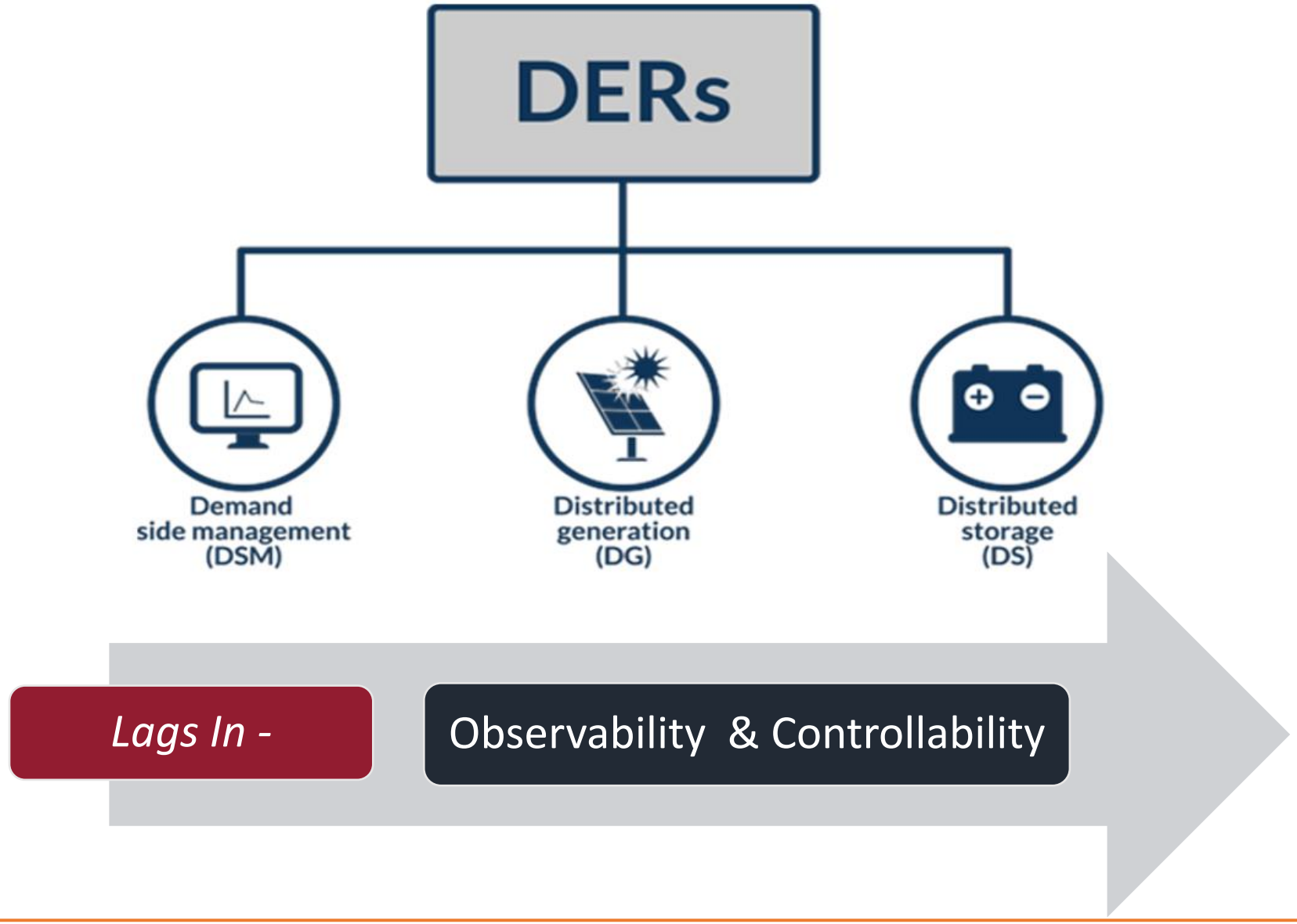
INTRODUCTION



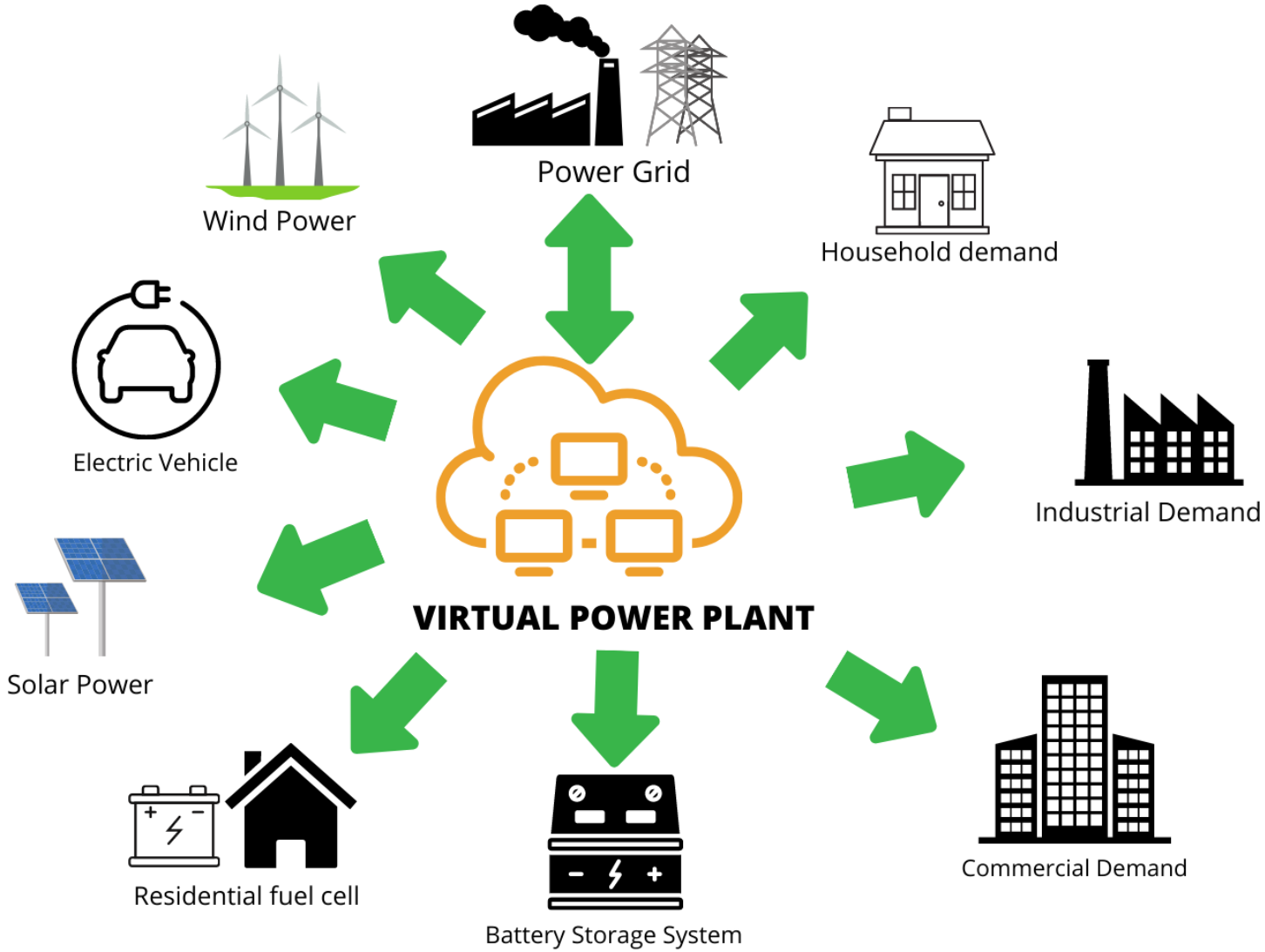
Why Virtual Power Plant

Current Challenge-

- Various Medium/ small capacity systems.
- Variable and random characteristics
- Reduced capacity compared to the entire power system

Need of Hour-

- Increased renewable & EV Integration
- In BSES Delhi alone-
  - > 163 MW;
  - > 6200 Points



Operation Flexibility in Power System

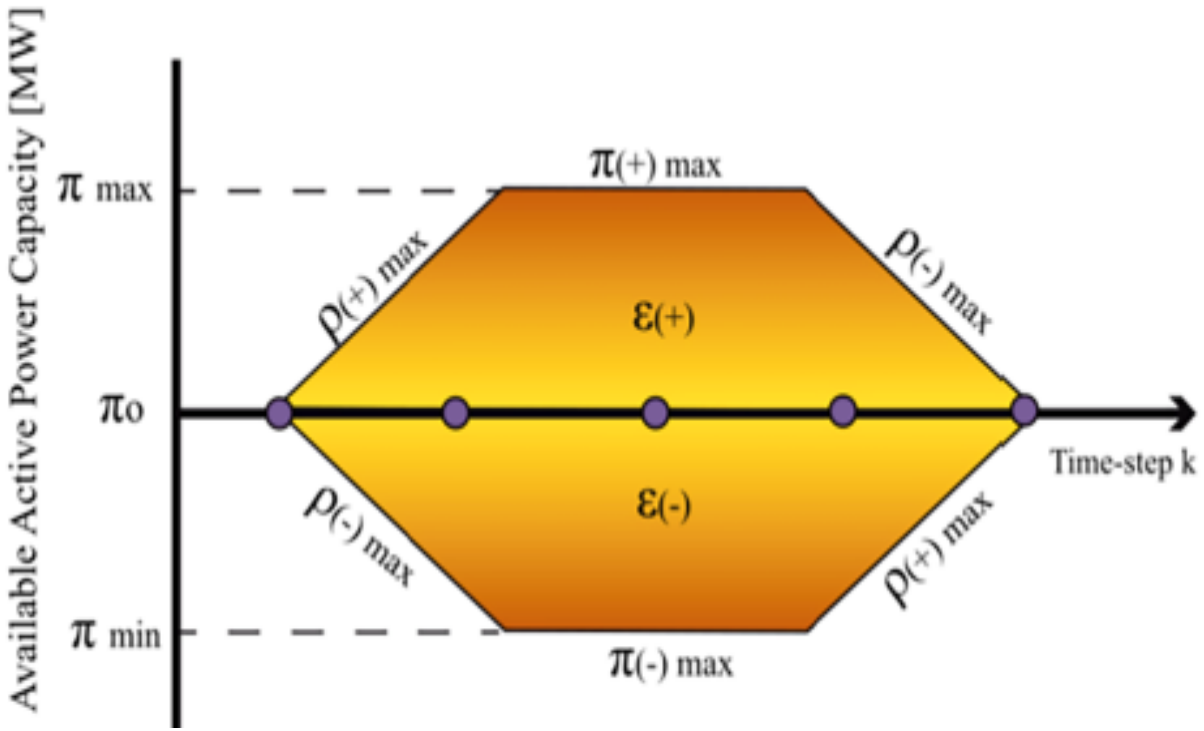
Parameter	Impact
Active Power	• Real time balance b/w generation and demand • maintains frequency stability
Reactive Power	• Maintain voltage levels
Energy requirements	• Balance b/w generation and demand
Transfer Capacity	• System Strength

Active Power Modulation

- Active power capacity (π), MW
- Negative values for storage units

- Modulation speed/ Ramp rate (ρ), MW/ min
- Ramp slope (+) or (-) depending on requirement.

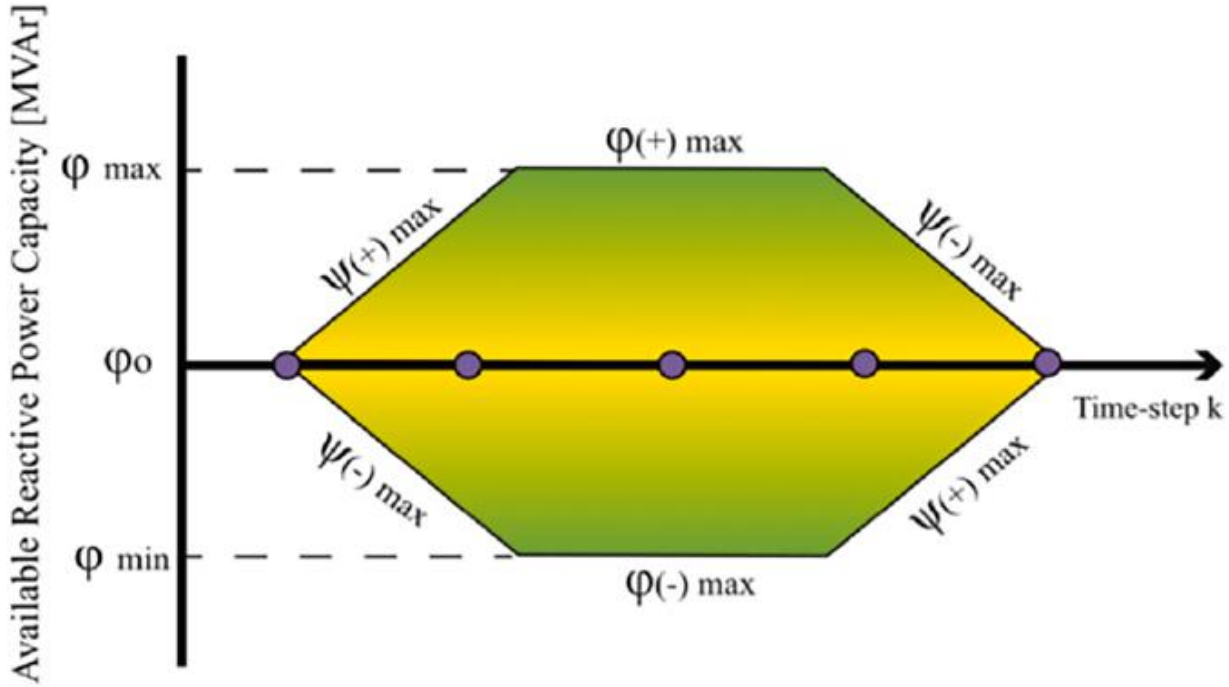
- Energy supply (ε), MW·h
- Express unit stamina
- Negative values for storage units



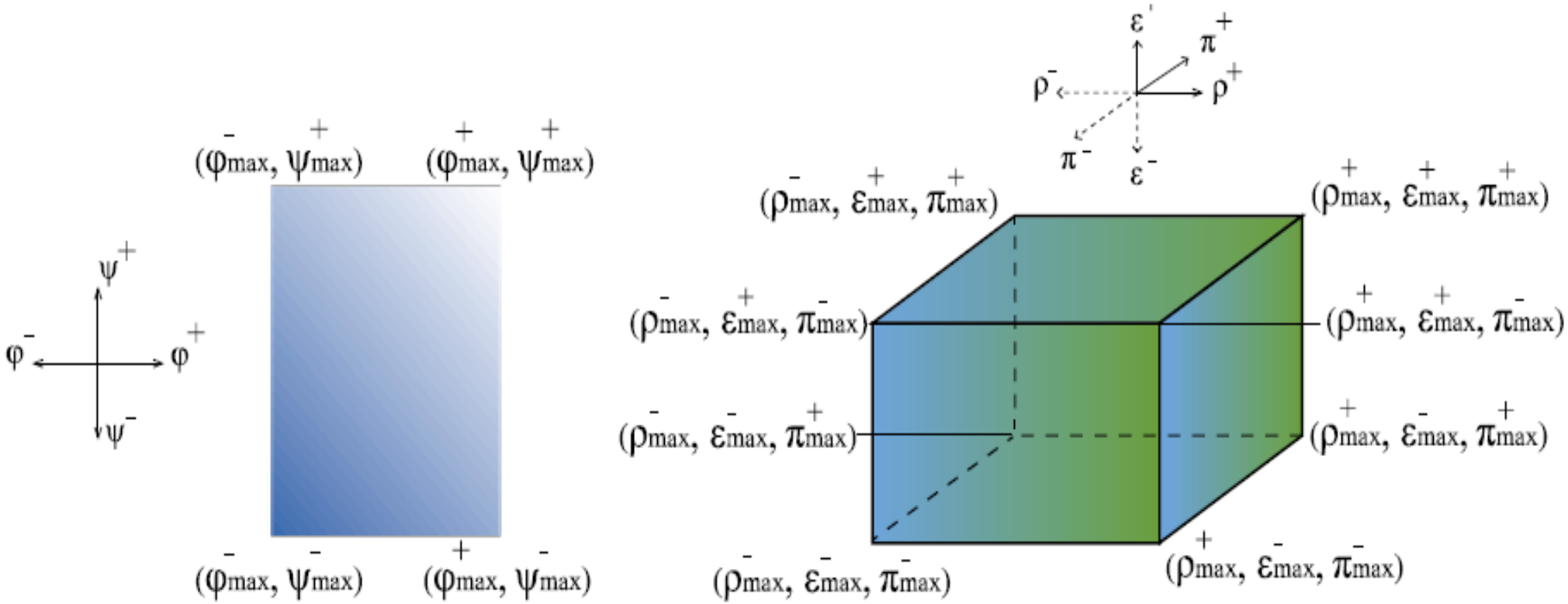
Reactive Power Modulation

- Reactive power capacity (φ), MVAr.
- (+) or (-) depending on technology of each unit.

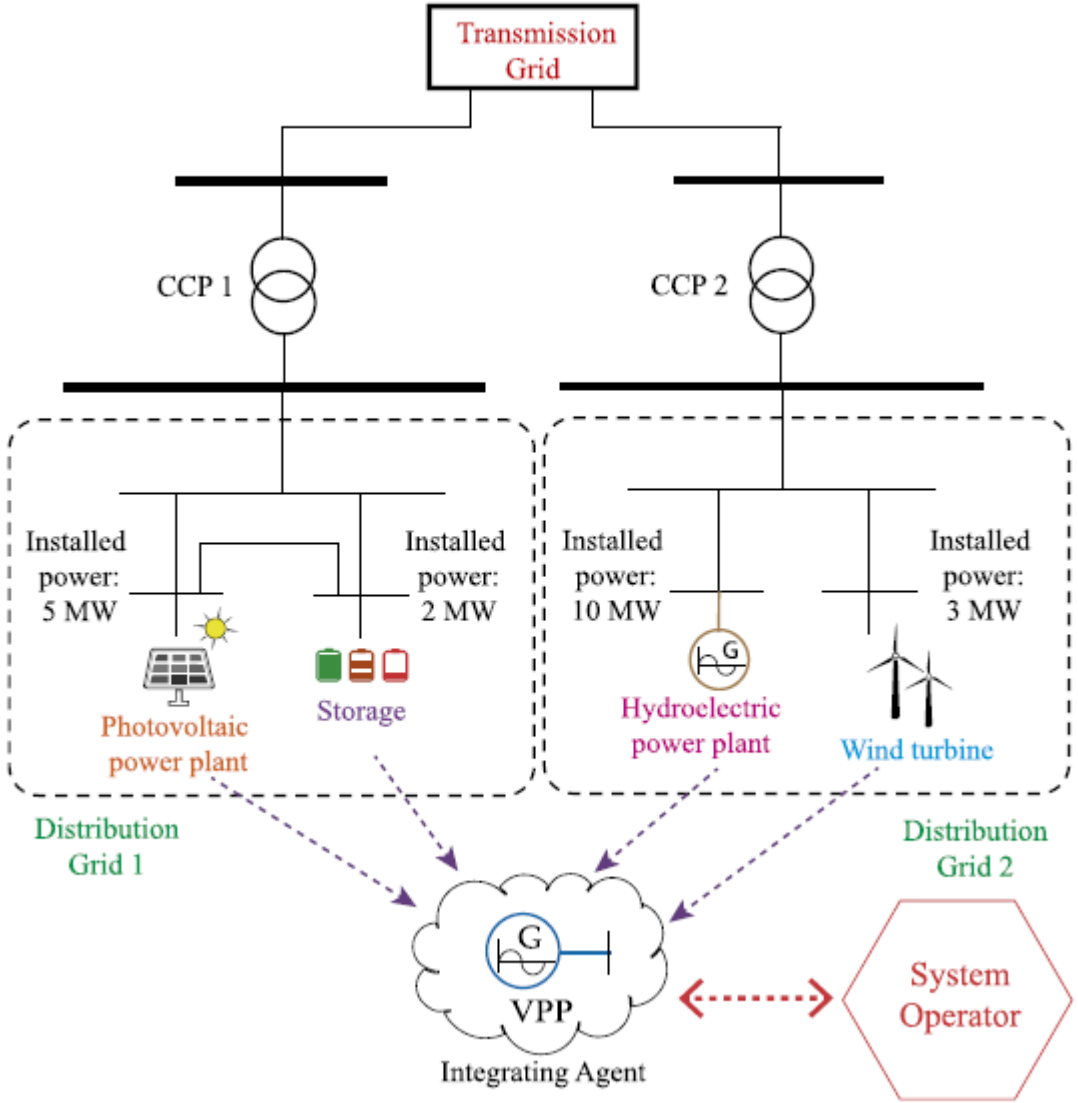
- Modulation speed/ Ramp rate (ψ), MVAr/min.
- Ramp slope (+) or (-) depending on requirement.



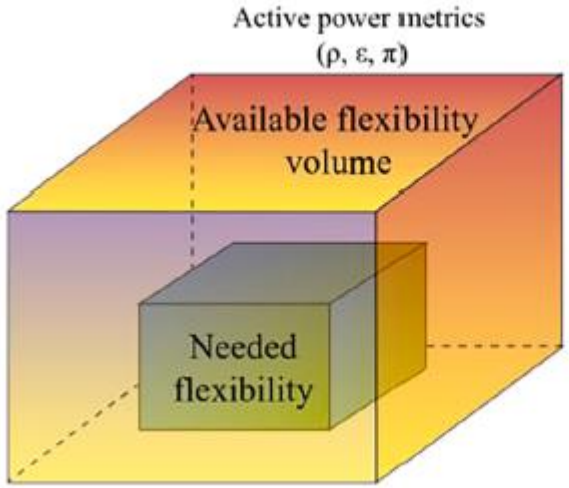
Active & Reactive Power Modulation



USE CASE


Transmission Grid
CCP 1
CCP 2
Installed power: 5 MW
Installed power: 2 MW
Installed power: 10 MW
Installed power: 3 MW
Photovoltaic power plant
Storage
Hydroelectric power plant
Wind turbine
Distribution Grid 1
Distribution Grid 2
G
VPP
Integrating Agent
System Operator

GW
135
130
125
120
115
110
Evening Peak
Morning Peak
Day Lean
Night Lean
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hours


Active power metrics
(ρ, ε, π)
Available flexibility volume
Needed flexibility

Reactive power metrics
(φ, ψ)
Needed flexibility
Available flexibility plane

Way Forward

- Cost effective solution
- System Modelling – setting DERs as a single virtual element
- Communication method
  - Smart Metering
  - Distribution automation
- Real-time access for each set of DER.
- DERs to participate in power exchange
- Interoperable Software & systems in interconnectivity domain.

THANK YOU

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