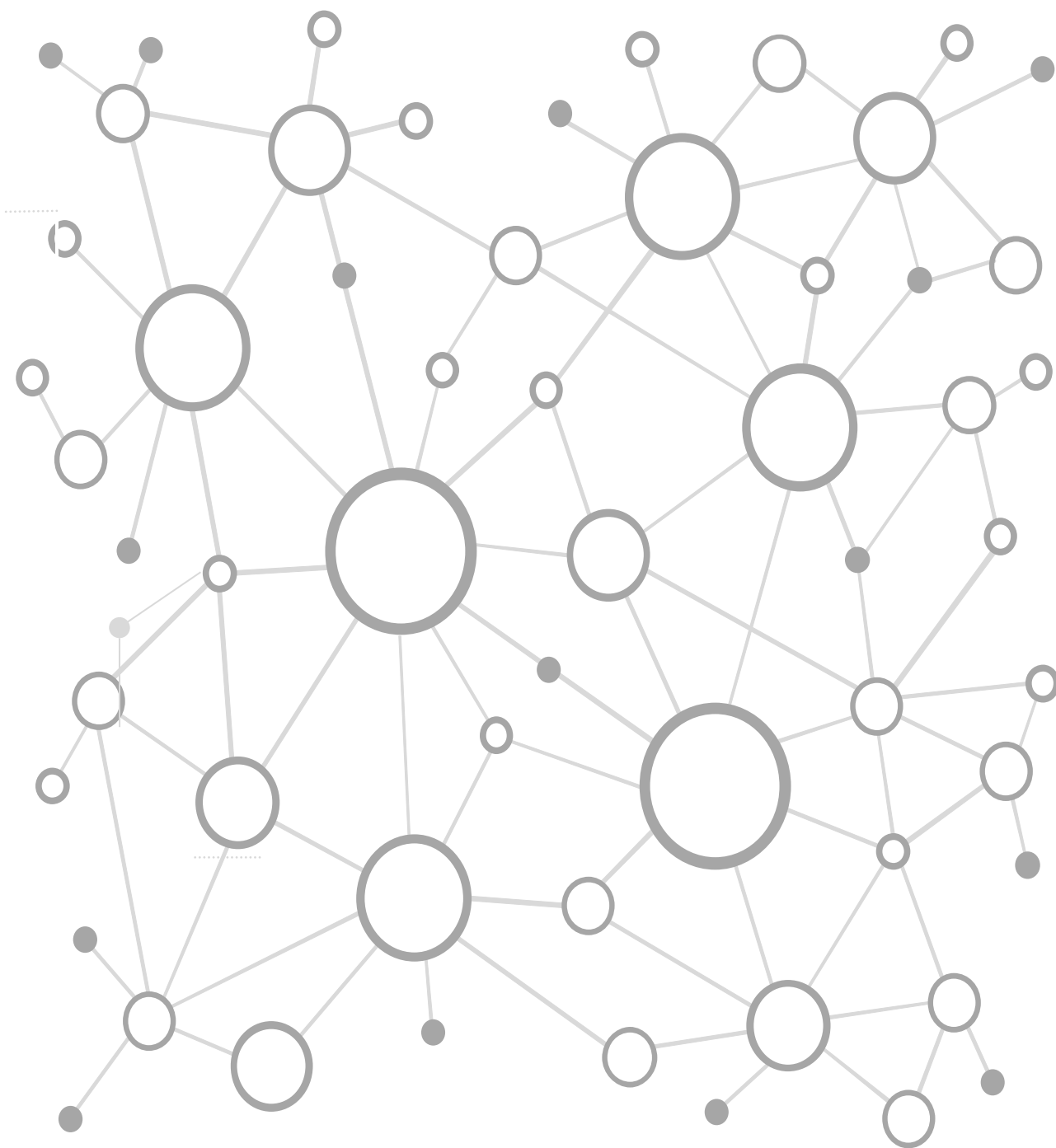


**SESSION 5:  
GRID INTEGRATION OF  
DISTRIBUTED Renewable Energy  
(DRE)**

**PRESENTATION**

**Distributed Solar  
Integration**

**Mr. Yogesh Gadkari**  
Director Commercial, MSEDCL



# Agenda

1

Distributed Solar Context: Maharashtra

2

AI/ML Driven Forecasting

3

Advanced Field & Automation Techniques

4

Flexible Grid Solutions & Capacity Building





# Distributed Solar Context: Maharashtra

*DRE is not an add-on; It is the new architecture of power distribution*

**Distributed Solar** is receiving high visibility and support at all levels & enabling **millions of distributed solar injection points**

Planning lens shifting from centralized adequacy to local hosting capacity at feeders and substations



**Rooftop  
Solar**



**4,84,984**  
Consumers  
(Nos.)



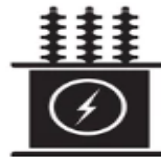
**4,151**  
Cap. (MW)



**15**  
100% Solar  
Villages (Nos.)



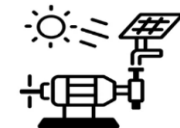
**Feeder  
Solarization**



**500**  
S/S (No.)



**2,716**  
Cap. (MW)



**6,89,610**  
Pumps (No.)



**DRE** forces **multidirectional flows** that existing systems cannot manage efficiently

- Reverse power flows from multiple injection points
- High variation in day-night load curve and uncertainty in solar output
- Voltage fluctuations beyond statutory  $\pm 6\%$  limit
- Emphasis on dynamic planning tools with predictive & real-time attributes



# AI / ML Driven Forecasting

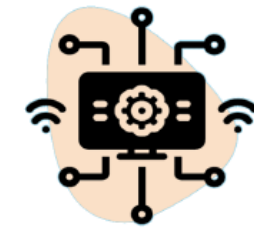
*Forecasting through Univariate and Multivariate time series models - utilizing*



## Forecast



## Optimize



## Automate

1

**Historical Demand Data**

❖ Integrated with advanced analytics and forecasting tool and AI based methods.

2

**Special Events**

❖ Scenario formulation based on future demand

3

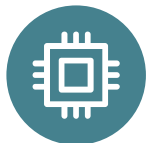
**Time Factor**

❖ Provides the schedule which optimally satisfy the constraint of technical minimum, ramp, MOD dispatch, special cases for Hydro, PSP & Interstate plants.

4

**Weather Data**

❖ Integrated with outage management, Zero Scheduling module providing the real-time cost optimized dispatches



MSEDCL is integrating an **AI/ML-driven module** to enhance grid stability and mitigate disruptions caused by large-scale deployment of Distributed Renewable Energy (DRE) sources.



# Advanced Field & Automation Techniques

## Advanced Field Technique- Substation Monitoring

*A low-cost, indigenous automation solution to enhance substation operations and business process efficiency*

### System Capabilities

- Real-time monitoring & situational awareness of remote substations
- Strategic planning
- Preventive maintenance & Corrective actions
- Transparent information transfer
- Substation equipment analysis & diagnosis

### Data & Decision Support

- Integrated dashboard at Central Control Centre
- Consolidated insights on grid performance and solar energy integration
- Data-driven decision-making
- Feeder demand monitoring, Energy accounting
- Load balancing

## Voltage Regulation- Reactive Compensation

*Its proper management ensures voltage stability and prevents power quality issues*

### Challenges

- Intermittent solar causes unpredictable reactive power demand changes
- Design limits of solar inverters constrain capacity
- DRE generation requires grid-code reactive-power standards for safe operation

### Solutions

Installation of supplementary equipment such as switched capacitor banks, static VAR compensators (SVC), or STATCOMs provide additional dynamic reactive support

### Integration with DRE Projects

**Maintaining** grid stability through developers -

- Maintain grid stability by means of installing capacitor bank
- Must pay all reactive-power charges and grid-drawn power charges per regulations
- Maintain the power factor within the limits of 0.95 lagging to 0.95 leading at Delivery Point
- Inject reactive power equal to 30% (thirty percent) of the active power generated in a month – penalty for shortfall @ 25% of tariff



# Flexible Grid Solutions & Capacity Building

## Battery Storage

**MSEDCL actively** developing **large-scale energy storage projects**, primarily using BESS –

- First BESS tender of 750 MW/1500 MWh floated in August 2024 – 10/ 20 MWh commissioned
- Second tender of 2 GW/4 GWh floated in July 2025
- Features - VGF Support, Land provisions, Technology agnostic, etc.

**MSEDCL has conducted technical feasibility studies through Optimization scheduling software** running various scenarios based on production cost analysis and identified optimum Energy storage scenario

**MSEDCL & GEAPP** collaborated to focus on integration of BESS to stabilize supply and manage peak demand, and management of DRE assets leveraging AI & ML;



- Emphasis on real-time asset monitoring, predictive maintenance, load flow analysis, and demand forecasting

## Capacity Building



With the emphasis on skill requirement of local support for the project developers, **Maharashtra Saurya Kaushal Yojana (Maha-SKY)** was spearheaded by the *Energy Department, GoM, & MSEDCL*

- **Skill Council for Green Jobs (SCGJ)** identified as the agency to design and implement capacity building program.



*Thank You*