Session : 6

Digital Twin for Distribution Grid

Presented By

Gopal Nariya, Head – CES & Automation, BSES Rajdhani Power Limited

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DISTRIBUTION UTILITY MEET DUM 2023
**ISGF** India Smart Grid Forum

## BRPL's Introduction & innovations being implemented by BRPL

➢ BSES Rajdhani Power Limited (BRPL) is a Joint Venture of Reliance Infrastructure
Limited (51%) with Delhi Power Company Limited (49%)
➢ Covering supply to South & West of Delhi since July'2022

Consumer Mix

About 87.15% residential (domestic) contributing to ~70% consumption

Distribution Area	695 sq. km
No. of customers	~29 Lakhs
Customer Density	4300 /sq.km
Max Demand met (7th July'22)	3457 MW
Annual Billed energy (FY 22-23)	13,149 MU
AT&C Loss (FY 22-23)	7.14 %
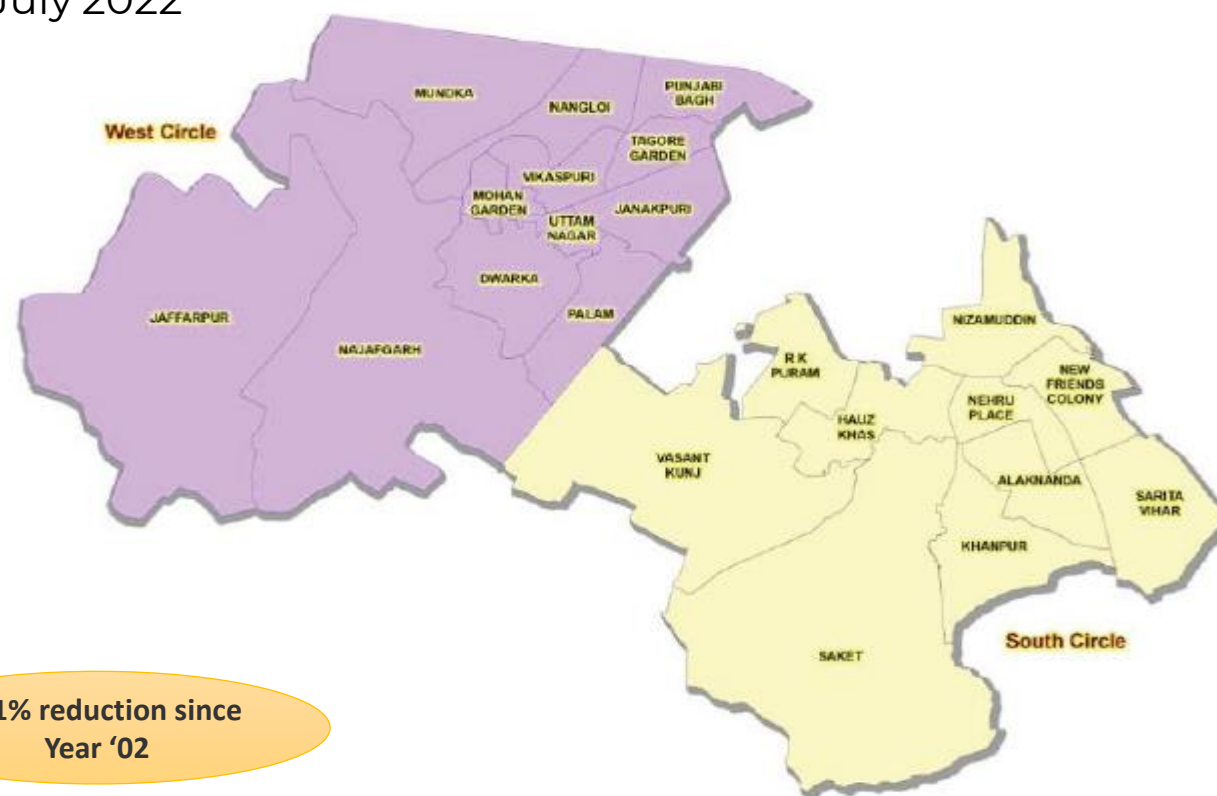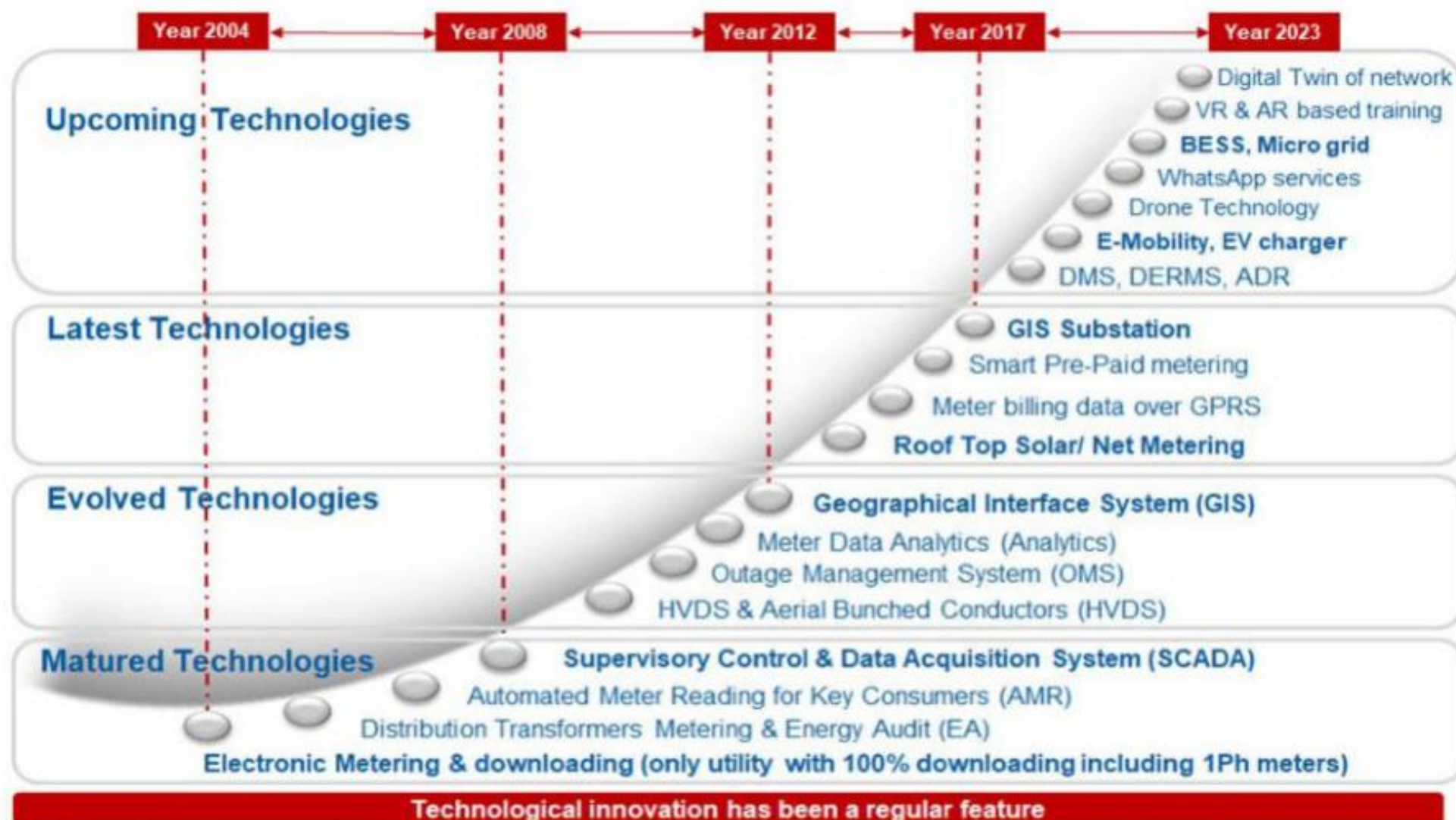
> 51% reduction since Year '02

Power sector – Historically digital

- Automated SCADA systems and remote monitoring of grid elements
- Smart meters
- EMS

External push and enablers for digitalization:

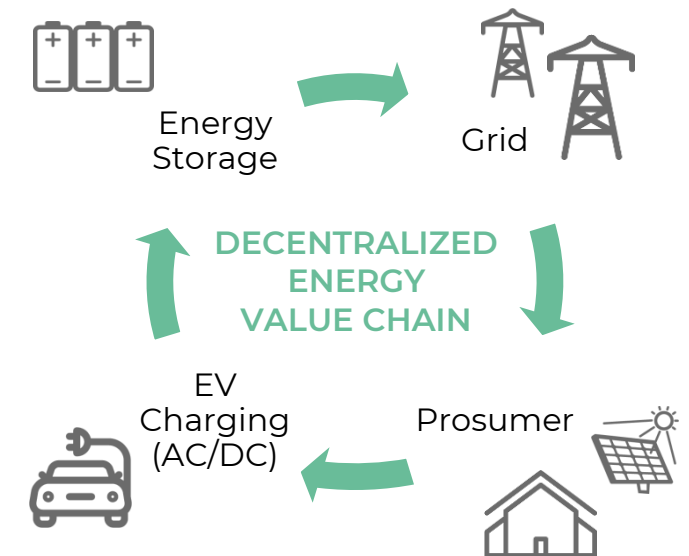|	
Fast increasing penetration of DER's	Demand Variation – Seasonal & Diurnal variation
Real time price markets with wider price ranges	Asset overloading during specific months/durations – DSM (Deviation Settlement Mechanism) Compliance
Maturity of digital technologies, cloud-based services, Smart Meter Roll-out	RPO Targets and Renewable Integration – Intermittent Nature of RE resources and No visibility of Prosumers' generation
Regulatory changes (unbundling, aggregators, flex integration)	Reliable and Quality Power Supply

Need for Digital Twin of Distribution Grid

Classic SCADA System View

No Visibility

Embedded generation

Storage, EVs etc

Distribution System Operator

Electricity transmitted at 275,000 or 4400,000 volts

Grid Supply Point

Large sub-station 132,000 volts

Primary sub-station 33,000 volts

Distribution sub-station 11,000 volts

Consumers 230 volts

Power Generation

Transmission Network

Distribution Network

Supply

TSO responsible for real-time balancing of generation and demand

Electricity meter

With an increasing **volatile and decentralized energy system**, there is a need to gain **greater insight and control** in the medium and lower voltage distribution grid

Energy Storage

Grid

DECENTRALIZED ENERGY VALUE CHAIN

EV Charging (AC/DC)

Prosumer

Journey to digitalisation – a digital twin of the distribution grid :

Adding the digital layer on top of the physical grid.

Source: IEC SRD 63200 – Smart Grid Architecture Model
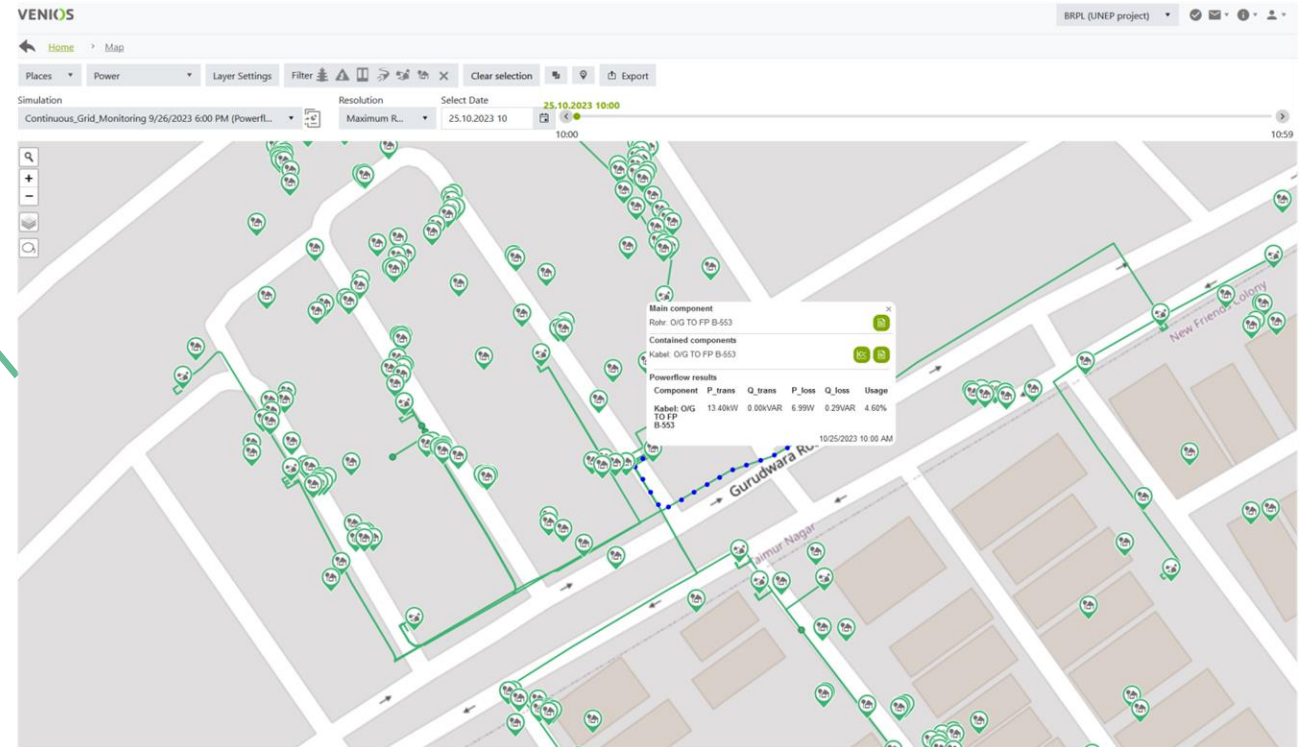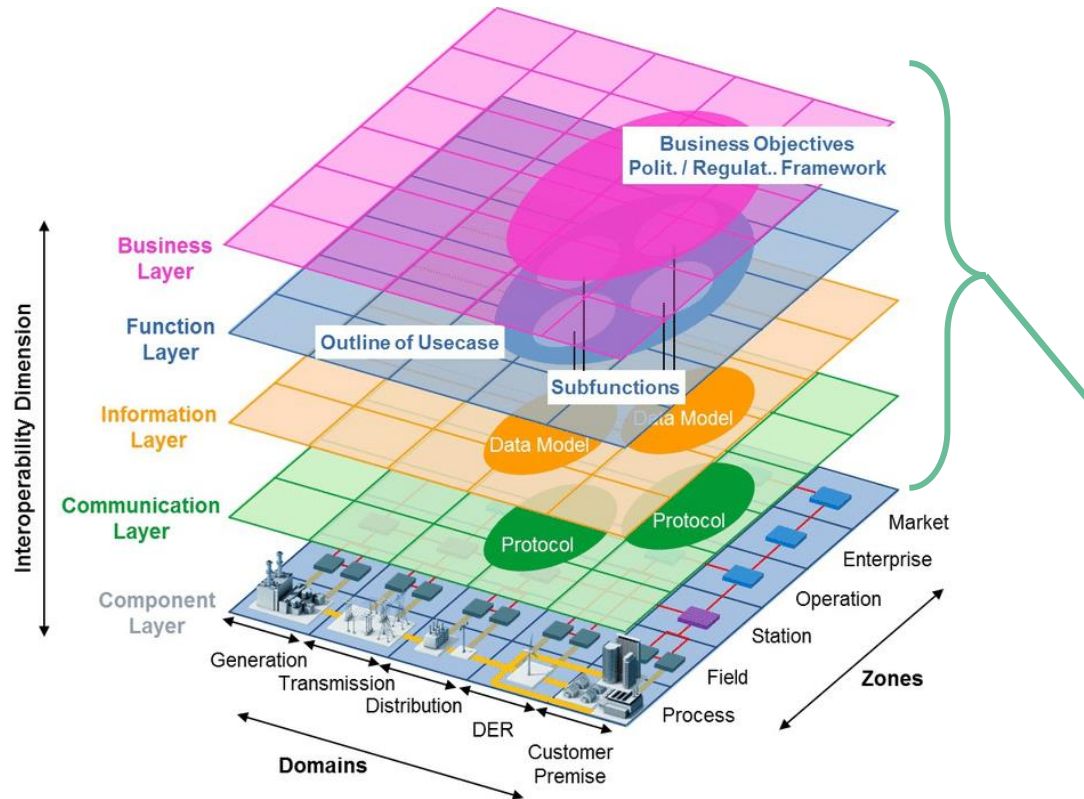
Venios.net energy platform adds and combines several dimensions (Communication ►Information ►Function ►Business)

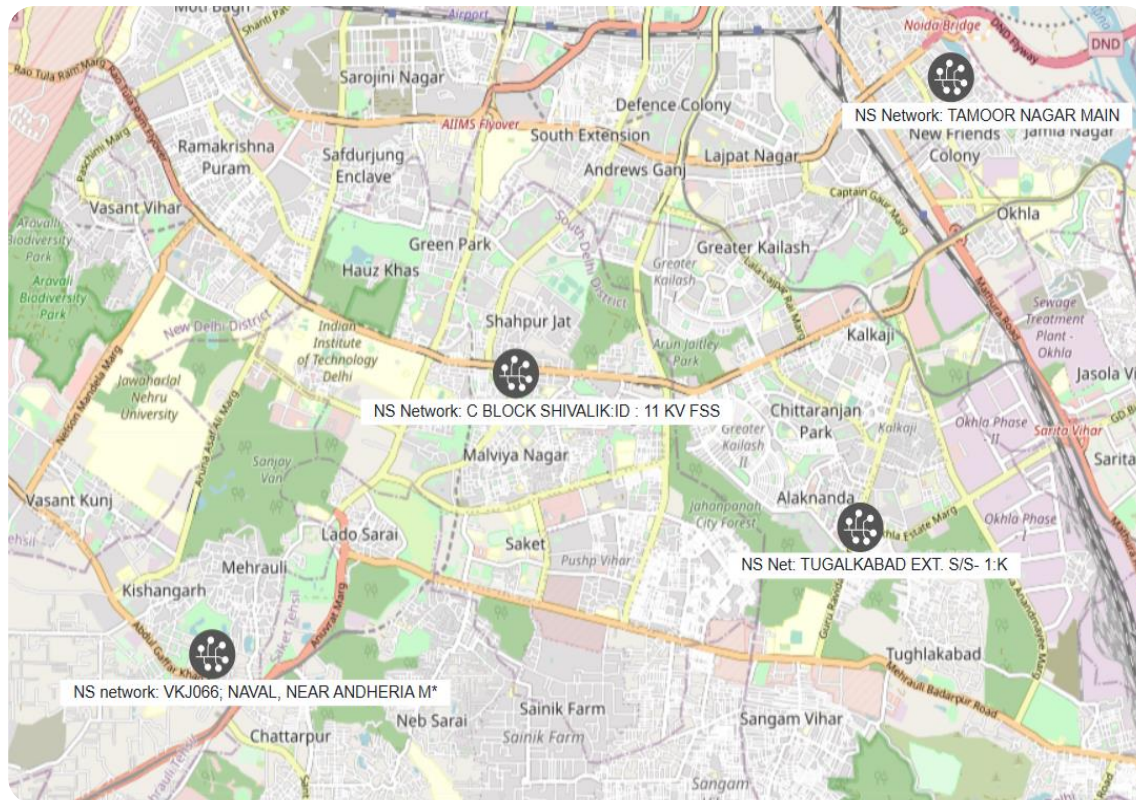# Digital Twin for Enhanced Electric Distribution Grid Operation and Management

GRANT NUMBER :   IND/UNEP/23401-001/3DEN/2022/002
GRANTEE NAME :   PANITEK POWER AG
Project partners :   Panitek Power, BSES Rajdhani, Venios, TERI
Implementation period :   December 2022 to July 2024

- Venios.net **digital twin platform** has been set up

- **Data integration** from various sources

- **six distribution transformers** at four locations with have been selected in southern Delhi area

- Around **3000 end consumer** connections

- Additional **power quality metering** devices have been installed at the DT and feeders for improved low voltage grid transparency

Real-time digital twin for grid management in the energy transition

The digital twin platform will enable utilities to digitize, monitor, forecast and control their low and medium voltage electricity grids by creating a real-time digital twin of the infrastructure.

Monitoring
- Integrate measurement data from versatile data sources
- Supplementation of missing measurement data with reinforcing asset models
- Real-time view on the congested areas in the grid

Intelligent Control
- Optimized control of flexibilities
- Adjustable local grid transformers for voltage level adjustment
- Control of e-mobility charging stations with intelligent and operator forecasts

Forecasting
- Day-ahead load and generation forecasts
- Grid status forecast: Early detection of bottlenecks
- Generate scenarios: Creation of "what-if" grid situations

Efficient Planning
- Intuitive system connection calculation: Easy handling, precise output
- Grid bottlenecks: Early recognition and intelligent action
- Asset manager: Derives actions based on current states

Digital Twin Pilot

UNEP Digital Twin Project – Identification of Distribution Network Challenges and Use Cases

Eight critical use cases identified, defined and analysed

Monitoring

Intelligent Control

Forecasting

Efficient Planning

1. **Grid Operation Analysis**

2. **Feeder Loss Validation**

3. **Transformer Overload Validation**

4. **Transformer Health Assessment**

5. **BESS Dispatch Strategy**

6. **Automated demand response**

7. **DER Integration and Grid Impact Analysis**

8. **Grid Optimization using digital twin platform technology**

Use Cases – Monitoring

Phase imbalance
(especially in summertime)
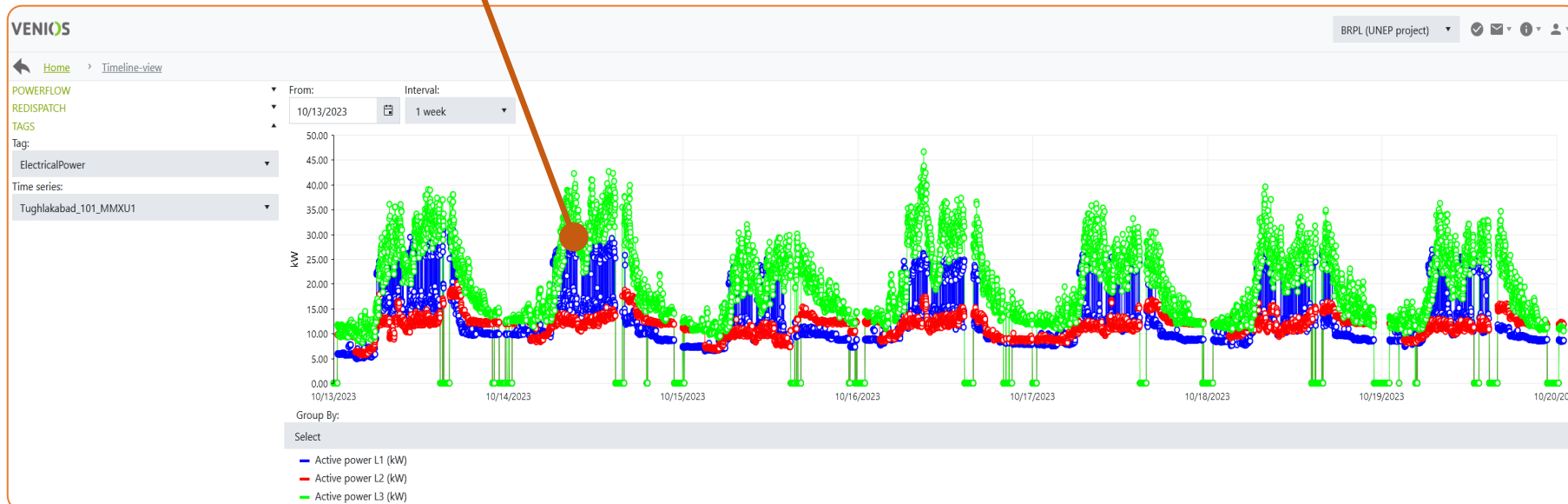► additional **DT & system losses**

partial (over-) **loading**
► additional **DT aging** expected

UNEP Digital Twin Project – Identification of Distribution Network Challenges and Use Cases

Eight critical use cases identified, defined and analysed

1. **Grid Operation Analysis**

2. **Feeder Loss Validation**

3. **Transformer Overload Validation**

Grid Operation Analysis:

- Through additional PQ meters and continuous load flow estimation, **preliminary analysis already showed relevance of selected sites** to be further analysed

- **Possible optimization potential is revealed**, which could be tapped in a suitable manner

- It can be shown that it is advisable to measure the transformer feeders to positively influence the network operation as early as possible based on **load flow forecasts**

- Based on first-order impact assessment, **economically positive results** are expected

- Digital twin solution can not only help with distribution grid balancing, but it can also point out were **consumer tagging needs to be updated** and support in GIS mapping

- **Grid Optimization using digital twin platform technology** – advance grid upgrade strategies based on scenario simulation

KEY TAKEAWAYS / RECOMMENDATIONS

- **Smart Meters** roll out is yet to come, only for billing will not leverage the technology & data analytics driven decisions

- Traditional SCADA/ADMS will not be able to tackle the data coming from vast amount different data points, **approach taken for HV/MV network will not work at LV level** and will not be able to provide satisfying results

- With more complex distribution network, **more visibility is required** into the LV grid elements to optimize the use

- Agility with data driven approach is required to take **informed decisions on grid operation and infrastructure planning**

- Although digitalisation will happen by itself because of economics of technology, **regulatory environment** can set the pace of digitalisation of distribution utilities

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THANK YOU

*For discussions/suggestions/queries email: **dum@indiasmartgrid.org***
www.isuw.in
Links/References (If any)

Consumer focused utilities

Consumer disrupting business model of utilities through digital means:
Rooftop solar
EV charging
IoT connected appliances
Increasing amount electrified heating and cooling

External push and enablers for digitalization:
Fast increasing penetration of DER's
Real time price markets with wider price ranges
Maturity of digital technologies, cloud-based services
Smart meter rollout
Regulatory changes (unbundling, aggregators, flex integration)