All India DISCOM Association

Webinar on Learnings from ENLIT Asia 2025 Summit

TGNPDCL

Agenda

1. Digitalization Powering ASEAN's Energy Future
2. Artificial Intelligence (AI) in Energy Sector & Need for Cybersecurity
3. Personalized Energy Retail — Data, AI & Demand Response
4. AI for Consumer Engagement & DER Optimization
5. Optimizing Energy Storage for Reliable Renewable Integration
6. Challenges in the Indian Context
7. Learnings from Best Practices of ASEAN Countries

Digitalization Powering ASEAN's Energy Future

Digitalization- Reimagining the Digital Utility

Smart Metering & Feeder Monitoring	Grid & Substation Digital Twins	Integrated IT-OT Architecture
Smart Grid Enablement	DTR/PTR Digitalization	DER-Centric Digitalisation
Predictive Analytics	Market Operations Automation	Asset Visibility & Reliability

Digitalization in ASEAN Countries

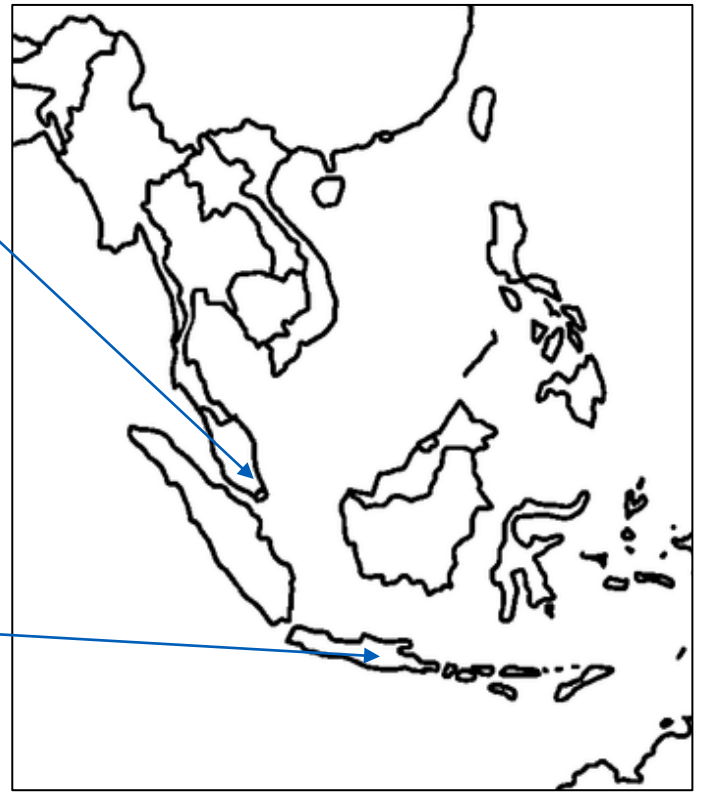
Singapore

National Grid Digital Twin: EMA and SP Group are building an Asset Twin and a Network Twin. Outputs already inform EV-charging capacity planning

Deployment of an end-user EMA tool is targeted in the current phase.

Indonesia

AMI Implementation: ~35 million customers to be converted to AMI by 2035, with multi-city pilots testing diverse comms tech to fit archipelago conditions.



India

RDSS smart metering: 20.33 crore meters sanctioned and 2.41 crore installed.

OUTCOMES

- Fewer outages, faster restorations
- Lower losses and better billing
- Smoother RE/EV integration
- More transparent benchmarking

Artificial Intelligence (AI) in Energy Sector & Need for Cybersecurity

Application of AI in Energy Sector

1. **Predictive Maintenance**
   Models on oil-gas, temperature, vibration, breaker counts, and relay mis-ops predict failures weeks ahead, reducing emergency outages and O&M.

2. **Outage Prediction & Faster Restoration**
   AI blends weather, vegetation, topology, and fault history to rank feeder risk, pre-position crews/spares, and cut restoration time.

3. **Loss Detection & Revenue Protection**
   Analytics over AMI/SCADA flag meter bypass, phase imbalance, and abnormal load shapes, improving billing accuracy and AT&C loss control.

4. **DER planning & Network Expansion**
   Algorithms can assess the growth of DER help plan power purchase and network expansion.

5. **Load Flexibility & Customer Engagement**
   Segmented baselines identify flexible loads; co-optimizing BESS with RE cuts curtailment, while personalized alerts improve customer experience.

Need for Cybersecurity in the Digitalizing Energy Sector

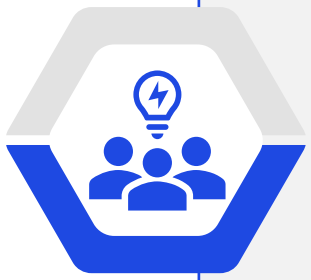
- ❑ Hackers can steal login details from IT systems and use them to access control systems like SCADA/DMS leading to unauthorized switching and delays in restoring power.
- ❑ Attackers use malware that speaks industrial protocols to send fake but valid-looking commands to devices, causing equipment stress and outages.
- ❑ Compromised software updates or third-party tools can hide backdoors.
- ❑ Fake or poisoned data can skew forecasts, maintenance plans, demand response payments, and energy storage decisions.

Cases of Cyber attacks

- ➢ Ukraine 2015: Phish attacks on remote SCADA control resulted in multi-hour outages, data wipers and call-center DDoS attacks.
- ➢ Ukraine 2022: An Industroyer2 cyberattack was detected early and stopped, thanks to CERT's monitoring and pre-planned response playbooks.

Personalized Energy Retail — Data, AI & Demand Response

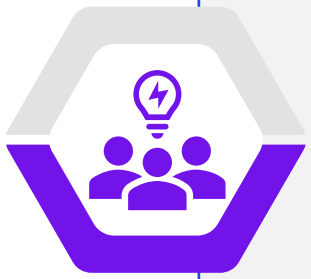
Using AI and demand response to personalize energy experiences and boost customer engagement.



A. Leveraging Data & AI to Drive Customer Engagement

- ❑ AMI + CRM data is unified to produce accurate, near–real-time bills with anomaly flags and high-bill alerts shown in mobile/web portals.
- ❑ Load-shape analytics generate simple usage patterns (hourly/daily graphs, peer comparisons) and surface plan options that fit actual consumption.
- ❑ Multilingual notifications and self-serve journeys (bill breakdowns, reminders, outage ETAs) reduce call volume and improve on-time payments.

Singapore: SP Group's "Energy Brain" applies AI to personalize usage insights in the SP Utilities app and to target household DR prompts with measured reductions.



B. Leveraging Demand Response in Personalizing Retail

- ❑ Customers are clustered by flexible loads (EV night-chargers, thermostat-ready homes, C&I HVAC/chillers), with each cluster linked to defined shift windows and payouts.
- ❑ Event prompts are delivered on preferred channels (app/SMS/WhatsApp) with one-tap accept/snooze; post-event statements show verified kWh reduced and credits.
- ❑ Cohorts are rotated based on responsiveness scores to limit fatigue while maintaining reliable MW delivery at feeder/substation level.

Singapore's Household Demand Response Pilot: Residential participants received time-boxed DR events via digital channels with telemetry supported verification and bill credits.

AI for Consumer Engagement & DER Optimization

01 Accurate Billing & Proactive Updates

AMI data is used to auto-detect billing anomalies and drive real-time outage & restoration notifications

Singapore's Smart Grid Index tracks such customer-empowerment capabilities.

Meralco's Metro Manila AMI program includes app-based bill and outage updates.

02 Optimizing Tariffs and Load Flexibility

Household load data is used to match customers with optimal tariffs and verify flexible load responses using high-frequency AMI readings.

Singapore uses granular AMI data and telemetry to match tariffs and validate flexible load responses in retail and DR pilots.

03 Improved Consumer Experience

Utilities segment by appliance mix, demand elasticity, and payment behavior to send simple, local-language tips that align with typical usage patterns

In Philippines and Indonesia, multilingual messaging is standard practice given diverse customer bases.

04 Storage/Der-aware Service

Customer communications are synchronized with DER and storage status, aligning notifications with expected solar output or local network conditions

Singapore's DER aggregation and VPP pilots provide the operational backdrop for such synchronized messaging.

Optimizing Energy Storage for Reliable Renewable Integration

Energy storage stabilizes renewable-rich grids by shifting energy across time and providing fast, dispatchable support.

Energy Storage in ASEAN

- BESS is installed at solar/wind plants, substations, and urban nodes for ramp control, peak shaving, and congestion relief.
- Storage improves renewable integration, reduces curtailment and stabilizes voltage/frequency
- Hybrid solar cum storage microgrids replace diesel in islanded areas, enhancing reliability and lowering fuel costs.

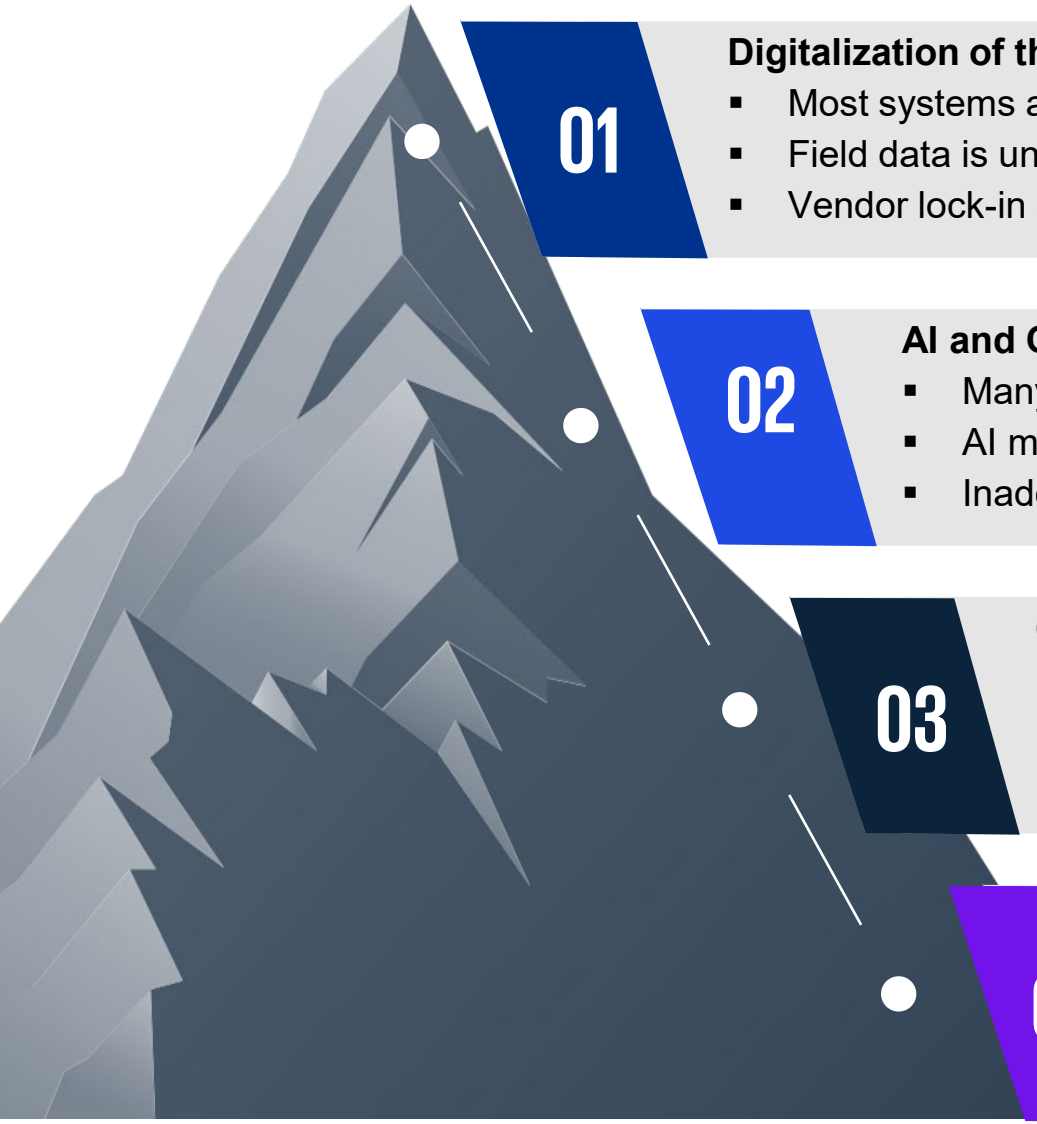
Vietnam's Storage Strategy

- Vietnam targets multi-GW BESS by 2030–2035, with deployments in RE projects and urban pilots.
- Measures include capacity targets, bundled RE procurement, and local manufacturing initiatives.
- Programs improve bankability and readiness in telemetry, protection settings, and dispatch coordination.

Advanced Storage Pilots

- **Singapore:** Ice-thermal energy storage integrated at a central substation to enhance urban resilience.
- **Thailand (Mae Hong Son):** Multi-MW solar + grid-connected BESS improving security of supply in a remote province.
- **Vietnam (EVN):** Utility-scale BESS (50 MW) as precursor to a broader program supporting RE integration and ancillary services.

Challenges in the Indian Context



01

Digitalization of the Energy Sector

- Most systems are not interoperable as data formats are inconsistent across platforms.
- Field data is unreliable due to outdated meters and slow syncing.
- Vendor lock-in and legacy systems make upgrades costly and slow.

02

AI and Cybersecurity

- Many OT devices aren't tracked or secured properly.
- AI models struggle with seasonal changes and may get skewed by anomalies.
- Inadequate experts in OT security.

03

Consumer Engagement & Personalized Demand Response

- Low adoption of smart devices and poor connectivity limit DR potential.
- Missing smart meter data breaks personalization and DR accuracy.
- Lack of standardized DR accounting framework.

04

Energy Storage

- Storage is expensive and batteries degrade quickly in hot climates.
- Safety standards are inconsistent and poorly enforced.
- Grid integration is tough due to weak data and varied conditions.

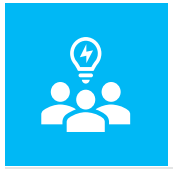
Learnings from Best Practices of ASEAN Countries

Digitalization of the Energy Sector

- ✓ Standardize asset data and APIs; treat operational data as core infrastructure.
- ✓ Digitize high-loss and RE-heavy zones first; build a unified GIS-based data platform.
- ✓ Use modular SCADA/DMS upgrades; adopt cloud/edge data lakes with open interfaces.
- ✓ Establish a Digital PMO with field tools; link funding to reliability and loss outcomes.

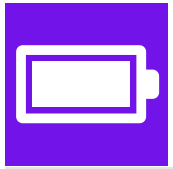
Artificial Intelligence & Cybersecurity

- ✓ Implement OT zero-trust with identity-based access and anomaly detection.
- ✓ Maintain device inventories; enforce SBOMs and patch SLAs from vendors.
- ✓ Prioritize AI for RE forecasting and asset health; apply MLOps discipline.
- ✓ Keep human oversight in safety-critical automation with defined fail-safe modes.



Consumer Engagement & Demand Response

- ✓ Ensure smart meter data quality and reliable baselines before personalization.
- ✓ Provide a unified customer portal for billing, insights, outages, and DR enrollment.
- ✓ Launch DR with clear rules, starting with C&I, then MSMEs, then residential.
- ✓ Pair dynamic tariffs with automation via approved aggregators and OEM partnerships.



Optimizing Energy Storage

- ✓ Deploy BESS for frequency regulation and congestion relief at RE nodes.
- ✓ Co-locate BESS with congested assets; engineer for heat and cycling durability.
- ✓ Use milestone-based approvals and auctions to attract private investment.
- ✓ Build ecosystem capacity with safety labs, training, and recycling pathways, especially for Battery Storage.

Thank You