Ministry of Industry and Trade

Hợp tác Đức
DEUTSCHE ZUSAMMENARBEIT

Implemented by
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

ERAV
Electricity Regulatory Authority of Vietnam

Task 2.1: International Best Practice on Smart Grid Roadmap

Mohamed Shalaby | DERlab

Thursday, March 10, 2022

Agenda

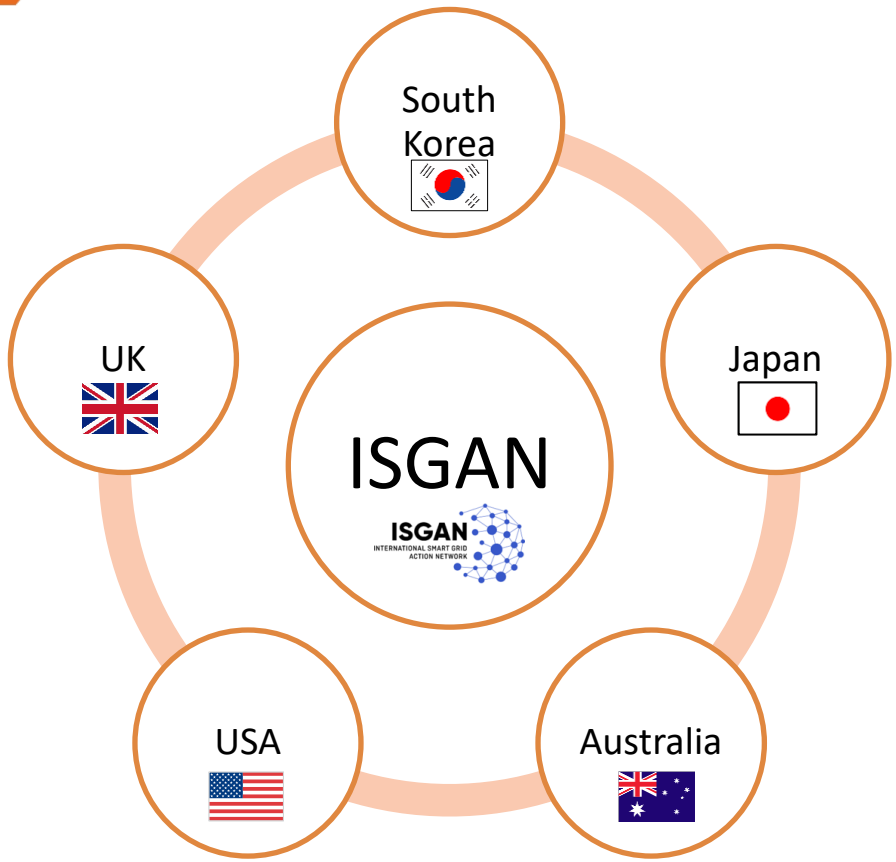
- Introduction
- Main outcomes (8 Indexes)
  - Monitoring & Control
  - Data Analytics
  - Supply Reliability
  - DER integration
  - Green Energy
  - Cybersecurity
  - Customer Empowerment & Satisfaction
  - Energy Index
- Discussion & Conclusion

Introduction

8 Smart Grid Index

Monitoring & Control	Data Analytics	Supply Reliability	DER Integration
Green Energy	Cybersecurity	Customer Empowerment & Satisfaction	Energy Market

International Best Practice Countries



ISGAN – International Smart Grid Action Network

Monitoring & Control

Monitoring & Control

- Data acquisition, monitoring and control of the entire transmission and distribution network
- Real-time network view and dynamic decision-making
- Decision support mechanism assisting the control room and field operating personnel
- Automatic fault location, isolation and supply restoration capabilities and an integrated outage management system in the event of network failure

Monitoring & Control

Monitoring & Control

Main outcomes (1)

- In South Korea, KEPCO has developed a top-level platform (xGrid) that connect various system in transmission & distribution and integrate them in real-time to better manage and operate national grid.
- In Japan, Hitachi is developing a PMU-based power grid operator assistance system, which will support the grid operators to mitigate major power grid failures.
- In Japan, there are two monitoring and control centres located at different locations to ensure business continuity even during major earthquake disasters.
- In Japan, Hitachi is developing an early deterioration detection model to assists in planning the replacement of deteriorated equipment.

Main outcomes (2)

- In Australia, the grid operator has visibility over HV & MV network, but limited direct monitoring on LV networks. Without monitoring LV networks, issues such as reverse power flow can hardly be identified in real-time. To overcome such issue, the grid operator decided to purchase this information from 3rd party devices e.g. smart meters.
- South Korea, Japan and UK are reinforcing their transmission network by building HVDC transmission lines.
- It is noted that in all analysed countries SCADA system is used to monitor the (ultra-) high-voltage and medium voltage. On the other side, some of the DSOs have limited monitoring on low voltage networks.

Main outcomes (3)

- DSOs install DMS/ADMS applications on their monitoring system based on their needs and the challenges that face the grid operator.
- Distribution generation is playing an important role in providing ancillary services.
- There are currently several R&D projects focusing on the cooperation between TSOs and DSOs to manage congestion. The IEA has published a relevant report presenting research projects focusing on the TSO/DSO cooperation "International R&D Project Collection – Advanced Cooperation between Distribution and Transmission Network Operation".

Data Analytics

Data Analytics

- Improve operation, maintenance and asset management
- Advanced Metering Infrastructure: Smart meters, communications networks and meter data management systems
- Smart devices to enable grid operators to monitor status of low voltage networks
- Advanced data analytics and its added value e.g. to better understand customer behaviour, consumption patterns, network reinforcement and asset renewal needs.

Data Analytics

Main outcomes (1)

- All analysed countries are currently upgrading their meters infrastructure and aiming to achieve 100% AMI.
- All analysed countries have automatic billing system and real time monitoring functionalities in their AMI.
- AMI provides customers with opportunities to participate in DR programs, where they are offered financial incentives.
- In UK the data collected by smart meters is analysed and used for better maintaining the electric grid and for network planning.

Data Analytics

Main outcomes (2)

- Demand Response Market
  - South Korea passed a legislation allowing demand response to participate in its wholesale capacity market.
  - In Japan, METI opened the “Negawatt” market for demand response.
  - The Australian energy market commission (AEMC) released rules in 2020 to attract more DR providers into the market. The network operator can switch off some of the loads during peak hours and customers get financial benefits.

Supply Reliability

Supply Reliability

- Analysis of the SAIDI and SAIFI and recommendations on how to improve them
- Recommendations to improve supply reliability
- Power quality (e.g. Frequency, voltage)

Supply Reliability

Main outcomes

- All analysed countries monitor SAIDI, SAIFI, FDI and VDI
- All analysed countries have mitigation plans to improve SAIDI, SAIFI, FDI and VDI
- South Korea & Japan reinforce old facilities and establish predictive maintenance to increase the network reliability.
- AMI helps the grid operators in identifying the location of outage and restoring it.

DER Integration

DER Integration

- Analysis the management of PVs, wind turbines, Bio energy and energy storage connected to grid
- Flexible loads to support the variability of DER

DER Integration

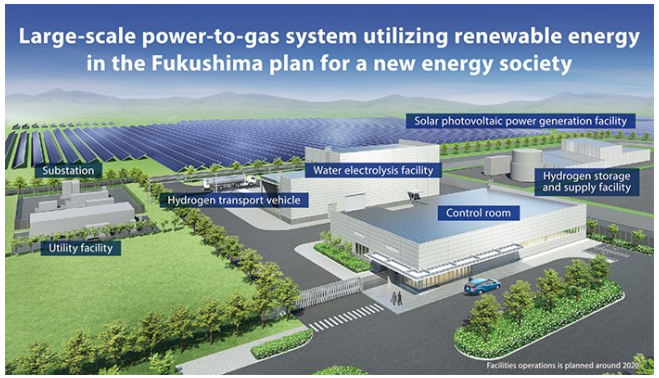
Main outcomes (1)

- All analysed countries have regulation allowing distributed energy resources to feed-in-grid.
- South Korea and Australia require from distributed energy resources to provide ancillary services to the grid.
- All analysed countries uses battery storage in varies applications to support the electric grid e.g.:
  - Frequency regulation
  - Spinning reserve
  - Voltage or reactive power support
  - Load following
  - System peak shaving
  - Load management
  - Storing excess wind and solar generation
  - Backup power
  - Transmission and distribution deferral
  - Co-location generator firming

DER Integration

Main outcomes (2)

- In Japan, there is the World's largest grid-connected battery with 720 MWh storage capacity. The batteries in this project would be used for managing the surplus wind power and helping power producers comply with Hokkaido's grid code.
- Most of the analysed countries either announced a hydrogen roadmap or currently drafting one.
- Biggest P2G demonstration in Japan
  - Electrolysis: 1.5 MW – 10 MW (Rate capacity: 6 MW)
  - Solar plant: 20 MW (Backed-up with the grid)
  - Hydrogen production: 1,200 Nm^3/h



Green Energy

Green Energy

- Renewable Energy penetration and its impact on reducing greenhouse gas emissions
- Energy programs (e.g. energy efficiency)
- Electric vehicles and its infrastructure (i.e. Smart charging, Vehicle-to-Grid solutions)

Green Energy

Main outcomes (1)

- All analysed countries are investing in renewable energy sources.
- All analysed countries have energy efficiency programs for residential, commercial and industrial.
- All analysed countries have set strategies for electric mobility.
- There are some pilot projects demonstrating smart charging & V2G to support the electric grid.
- All analysed countries have set targets to reduce carbon dioxide emission.
- The energy efficiency programs in South Korea is expected to reduce the peak demand by 3.9 GW in 2023 and 5.7 GW in 2027.

Green Energy

Main outcomes (2)

- Japan has relatively low energy intensities (high energy efficiency), place 11 among IEA member countries in 2018.
- The Japanese government set a goal to have a fast charger every 15 km or within every 48 km radius.
- After Fukushima disaster, V2H has been commercialised and it is used power buildings in case of emergency.
- In Japan, V2G technology has been tested for frequency regulation to stabilise the grid.
- The UK government announced a plan to end the sale of new petrol and diesel cars from 2030 onwards.

Cybersecurity

Cybersecurity

- Cybersecurity measures and management to safeguard the energy system against attacks
- Compliance with cybersecurity standards

Main outcomes (1)

- The power system is under the rising threat of cyberattacks due to significant growth in instrumentation and automation at the level of the bulk power system.
- In 2014, the South Korean power system was attacked and plans and manuals related to two nuclear reactors, electrical circuits, and data on more than 10,000 employees were stolen.
- In South Korea, MOTIE established a Cyber Security Center, which acts as operational agent to conduct real-time monitoring for cyberattacks, response and information sharing and communication infrastructure.
- The Korea Power Exchange (KPX) identified that up to 95% of cyberattacks come from abroad and has implemented a blocking prioritisation scheme that shields web-connected software from international connections.

Main outcomes (2)

- On the weekend of 27 November 2021, the energy provider CS Energy in Australia announced that their ICT network was cyberattacked and the company managed to avoid the shutdown of the generators (3.5 GW).
- The DOE in USA created in 2018, created cybersecurity, energy security and energy response (CESER) office, which energy infrastructure in developing cybersecurity protections to improve the reliability and resilience of US energy delivery systems.
- In UK, the AMI was designed, so that each message received by a meter is authenticated via a cryptographic algorithm where the meters all have unique authentication keys. The authentication code is unique to each message and each meter.

Customer Empowerment & Satisfaction

Customer Empowerment & Satisfaction

- Real-time energy consumption data and pricing information
- Awareness for customers about their energy usage and enable them to manage their consumption and lower energy costs

Customer Empowerment & Satisfaction

Main outcomes

- It is noted that customer satisfaction surveys are conducted on regular bases in all analysed countries.
- All analysed countries provide customer with real-time monitoring for their energy consumption.
- All analysed countries enable customer to participate in demand response campaign and receive financial benefits.

Energy Market

- Flexibility and ancillary service energy market
- Business models for Demand Response

Energy Market

Energy Market

Main outcomes

- All analysed countries shifted/are shifting from monopolistic position in the production, transmission, distribution, and sales segments to open market with different actors.
- All analysed countries enable customer to participate in demand response campaign and receive financial benefits.

Discussion & Conclusion

Thank you for your attention!