JAPAN-RE INVEST INDONESIA FORUM

THE IMPORTANCE AND DIRECTION OF SMART GRID IN INDONESIA

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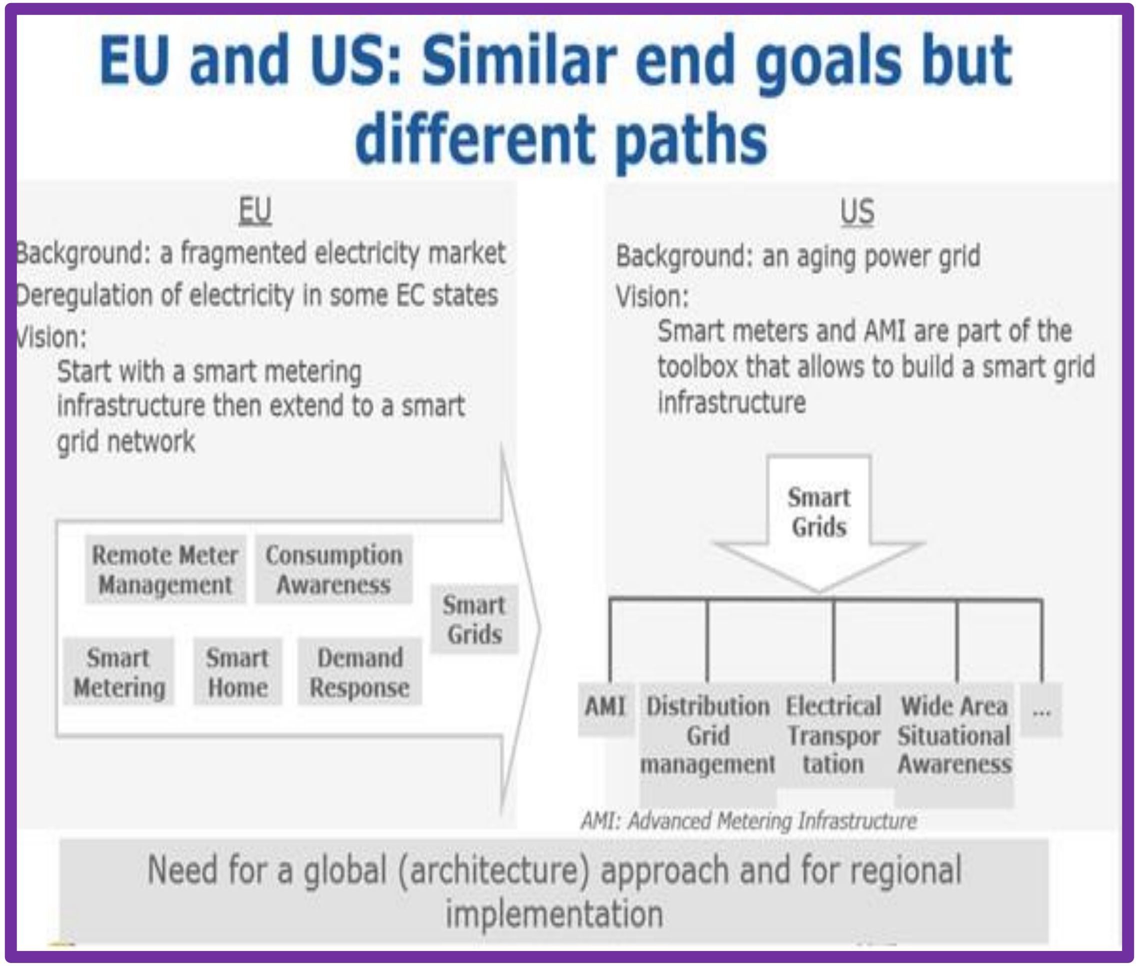
INTRODUCTION ON SMART GRID

- The **global transition** towards sustainable, secure, and affordable electricity supply is driving changes in the consumption, production, and transportation of electricity, resulting in a consensus that a **‘smart grid’ will pave the way to decarbonization, reliability, and efficiency in the electricity sector**.
- Smart grids can be defined as electricity networks that **enable two-way communication and power exchange between electricity consumers and producers,** utilizing information and communication technology (ICT) to manage demand, and ensure safe and secure electricity distribution (DOE 2006).
- A smart grid can support the **reliability of the grid** with the penetration of distributed generation and electric vehicles (EVs), and can deliver possibilities **for real-time management of electricity demand, production, and storage**.
- It can be observed that the **political economic context** influences the motives for investing in smart grids. Nonetheless, not each investment necessarily contributes to the sustainability and affordability objectives from a greater social perspective.

- The conflicts between **different policy objectives and the interests of the actors** involved present an interesting point for research.

DEFINITION OF SMART GRID



Source: ETSI, 2010

- Technically speaking, it is not straightforward to define whether a grid is ‘smart’ or not ‘smart’.
- Most systems, at least at the high voltage levels, have technologies in place in order to sustain reliability of supply with supervisory control and data acquisition systems (SCADA).
- However, distribution grids have traditionally been managed in a passive manner and therefore smart grids generally refer to new developments on the distribution side.
- Aspects of smart grids that can represent such developments are: (i) the installation of physical ‘smart devices’, and (ii) the (real-time) operational management of those device

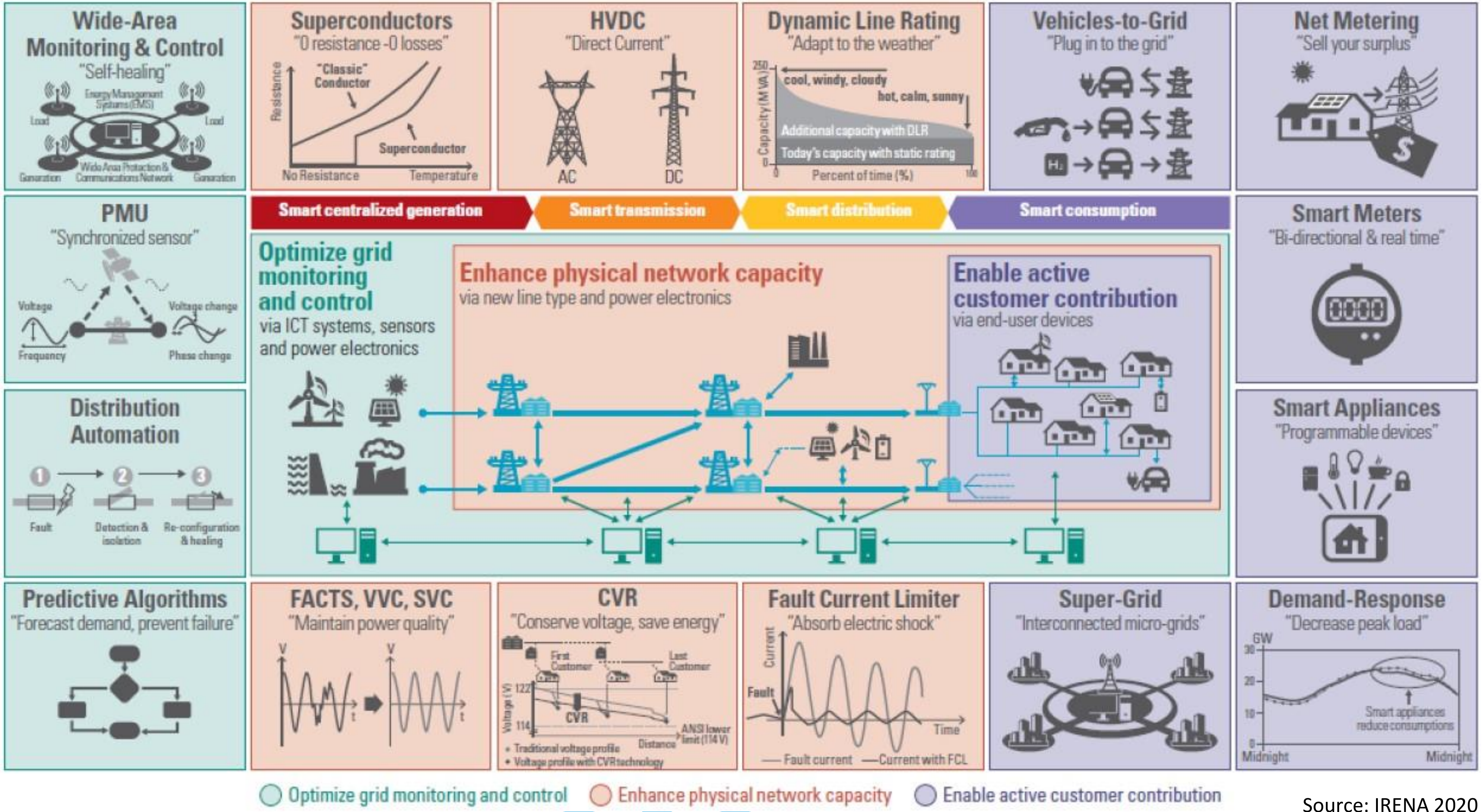
THE BASIC SMART GRID FUNCTIONS

	Smart Grid Functions					
Smart Grid Components	Asset utilization & efficiency	RE & DER integration	Reliability & Power quality	Self- healing	Customer engagement	New product & service
Power Generation	**D1**		**D1**	**D1**		
Transmission	**D1**	**D3**	**D1**	**D1**		
Distribution	**D1**	**D3**	**D1**	**D1**	**D2**	
Retail /Customer		**D3**			**D2**	**D2**
Procedure/Policy		**D3**	**D2**		**D2**	**D2**

- Improving efficiency, reliability and resiliency through automation and digitalization along the utility supply chain (*digitalization*) **D1**
- Engagement & empowering Customer to be “PROSUMER” (*decentralization*) **D2**

- Increasing Renewable energy penetration by enabling Grid flexibility (*de-carbonization*) **D3**

SMART GRID APPLICATIONS



Source: IRENA 2020

Why Indonesia need Smart Grid

- To allow integration of large number Distributed Generators ; i.e ; mini/micro hydro, wind, solar and other micro generators in order to meet commitment of Paris Agreement. (Energy Transition Goal)
- To cope with the intermittency nature of both generation side and consumer/prosumer side. (PV Rooftop, PV Farm, Wind Generators will be the logical choice to meet the energy transition goal in time.
- To support the idea of Island Interconnection : PEKIK NUSANTARA.
- To better cope with changes in weather; disaster, attack and other emergency situation (Covid-19 pandemic, earthquakes, floods , hurricane etc)
- To achieve higher reliability, quality and flexibility/resiliency of power system while increasing consumer active participation in daily system operation. (toward the emergence of communal utility)

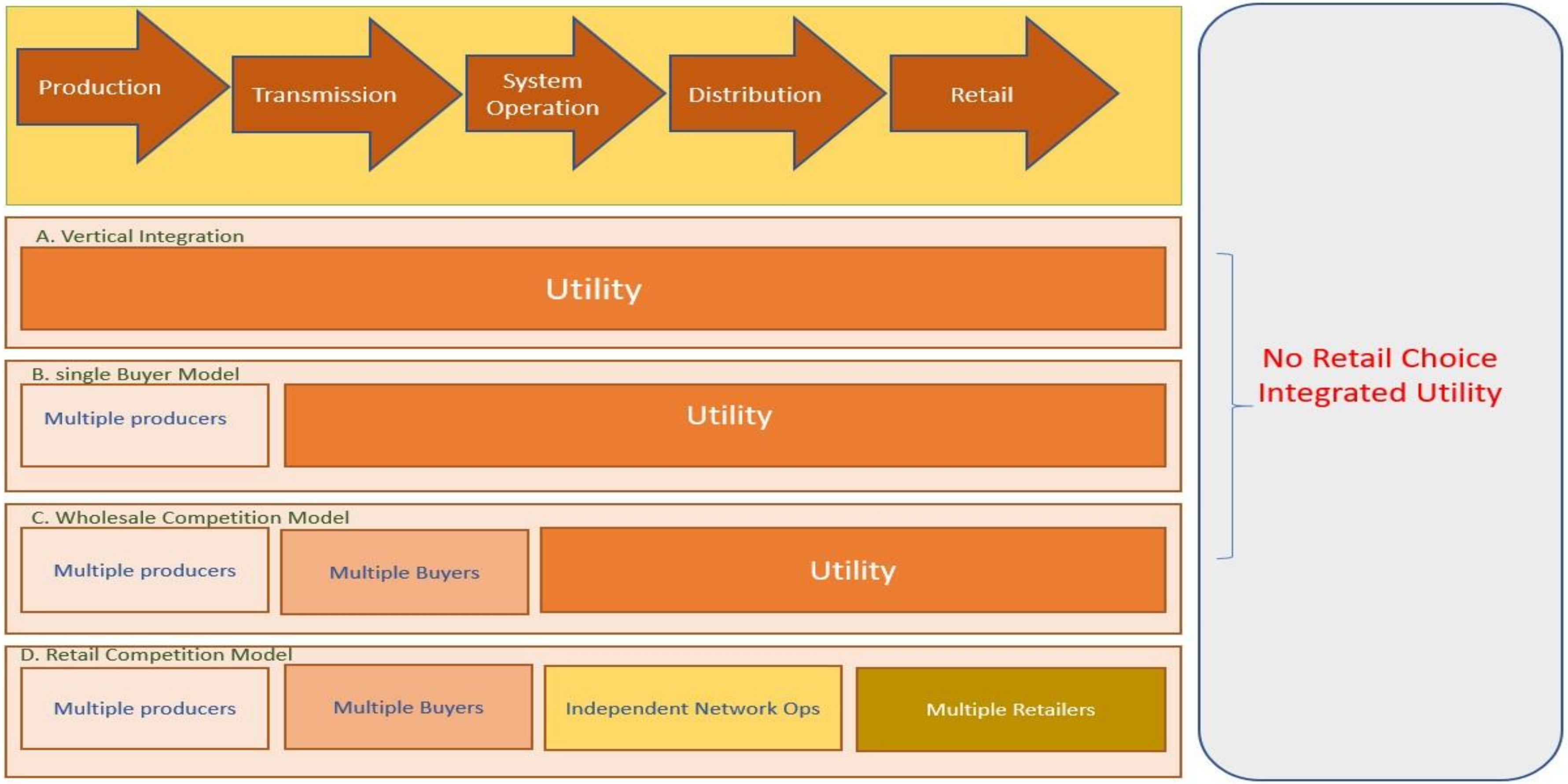
Why SG development in Indonesia is slow

- To support further technology development. i.e. block-chain, energy storage, superconductors ; industry 4.0

- The Energy Transition process in Indonesia are slow; PLN still relies heavily to fossil, Government are still in the process of unifying various objectives that provide reasons not too hasty in transition.
- As the sole Transmission and Distribution asset owner, PLN are still entrenched in their problems of solving 35 GW projects and overcapacity, weak demand growth, and its impact on PLN's financial situation. SDG is low in their priority list.
- Government , without full technical support of PLN, seems to be timid in their regulatory development.

- Industrial and Commercial customers are not actively pursue the digitalization process on system wide, but rather to implement it within their boundaries
- Vertically Integrated
- the price of demand response (of flexible demand) is not competitively set
- Strategic behaviour against adoption of cost efficient innovation

The Impact of Industry Structures



- Single Buyer Model
- Wholesale competition Model
- Unbundled TSO
- Retail Competition
- unbundled DSO (legal or ownership)- Transfer of benefit to sister co.
- administratively – Holding maintain financial links

The Impact of *Energy Policy

- There are different ways in which regulators can settle the remuneration for regulated companies.
  - **Incentive-based regulations** motivate utilities to reduce OPEX and/or CAPEX in line with an efficiency factor.
  - Alternatively, with **rate of return or cost of service regulation**, CAPEX can be more easily recovered if the regulator deems such investment as prudent.
- CAPEX for smart grid investments require regulator approval to be recover
- Policy includes Instruments to motivate investments in smart grids. Policy could be top-down, bottom-up, or hybrid model.
- certain aspects of the smart grid, for example the smart meter, could be legally enforced by law (top-down), or this could be left to the interests of the utilities involved and the consumers.
- For Smart Meter Italy and Sweden choose Top-down, while in the EU in general **a hybrid approach** , while US is more to bottom up approach..
- By contrast, in China, **a top-down approach** is applied, with the state grid company depending entirely on the policy directions given for the roll-out of smart grids.

Sources of the socio-political tension

Table 17.1. Summary of policy perspectives on smart grids

	United States	Europe	China
Industry structure	Mostly vertically integrated or wholesale competition	Retail competition	Vertically integrated
Regulatory model	Cost of service/rate of return regulation	Incentive regulation for DSO	Rate of return regulation
Energy policy	Bottom-up	Hybrid	Top-down
Initial smart grid interests	Reliability and recovery of investments for utilities	Affordability and sustainability	Supply surge of electricity demand in reliable and sustainable manner
Smart grid developments	Smart metering applied in many places, but no greater smart grid vision. End user left passive in many cases	Smart metering roll-out only fully completed in Sweden and Italy. Remaining problems are the role of the DSO	Large-scale projects, including smart metering, micro grids, and EV pilot projects are deployed on larger scale, where direct control is applied by state grid company

Indonesia

Vertically Integrated

Rate of Return Regulation

Top Down

DER , EV Urban Convergence Netwk dev'ment

Small to medium size projects, except Large scale Hydro & Solar Projects

A. THE POLICY & REGULATION- INVESTMENT FOR SMART GRID

- **The aptitude of smart grid investments depends on the regulatory scheme applied in the sector.**
- *For example, In Indonesia with cost of service regulation, capital expenses (CAPEX) in smart grids could be more easily approved if the regulator deems such investment as prudent, especially if investments would help to solve imminent grid congestion or supply constraints.*

- The integration of IT and smart grid devices might reduce the need for grid reinforcements or production investments by optimizing the integration of distributed generation.
- However, many smart grid investments not only involve CAPEX, but also increase operational expenses (OPEX), *for example for the procurement of flexibility in real-time operations.*

- **Policy makers could support smart grid investments (CAPEX and OPEX) by allowing them to remain outside the regulatory benchmark. (sandboxing regulation)**

- Investments in smart grid control devices and metering improve the DSO's ability to decrease operational and investment expenses. A DSO can benefit with smart metering from a reduction in metering costs, but the real benefit will come when a proper application is applied to data obtained and reveal a new string of value.

- ***Another issue with smart grid developments and the position of integrated utilities is that due to the monopoly position of the utility, the value, and hence, the price of demand response (of flexible consumption) is not competitively set.***

Consequently, investments may be hampered by a lack of proper economic incentives discouraging cost-efficient innovation

THE WAYS TO ACHIEVING A FLEXIBLE ELECTRICAL SYSTEM

Grid Hardening;

- Effort to add/ expand new distribution lines, re-conductoring, up rating Substations, Transformers etc
- Implementation of FACTS (Flexible AC Transmission System) Technology
- Implementation of RACDS (Resilient AC Distribution System) Technology
- Interconnection and HVDC Technology application

Grid Smartening;

- Adding intelligent sensors; Advance Meter Infrastructures
- Improving SCADA System; Increasing visibility and controllability of System Operation
- Shortening interval of data retrieval & Reducing latency of data transmission

Greening the grid:

- Improvement in System Planning
- Wide Area Management (WAMPAC)
- Advance Forecasting for balancing demand and supply; Unit Commitment : day ahead ; hourly interval
- Virtual Inertia Technology.
- Developing efficient Ancillary Services : Energy Storage System (ESS)

Responsive Demand;

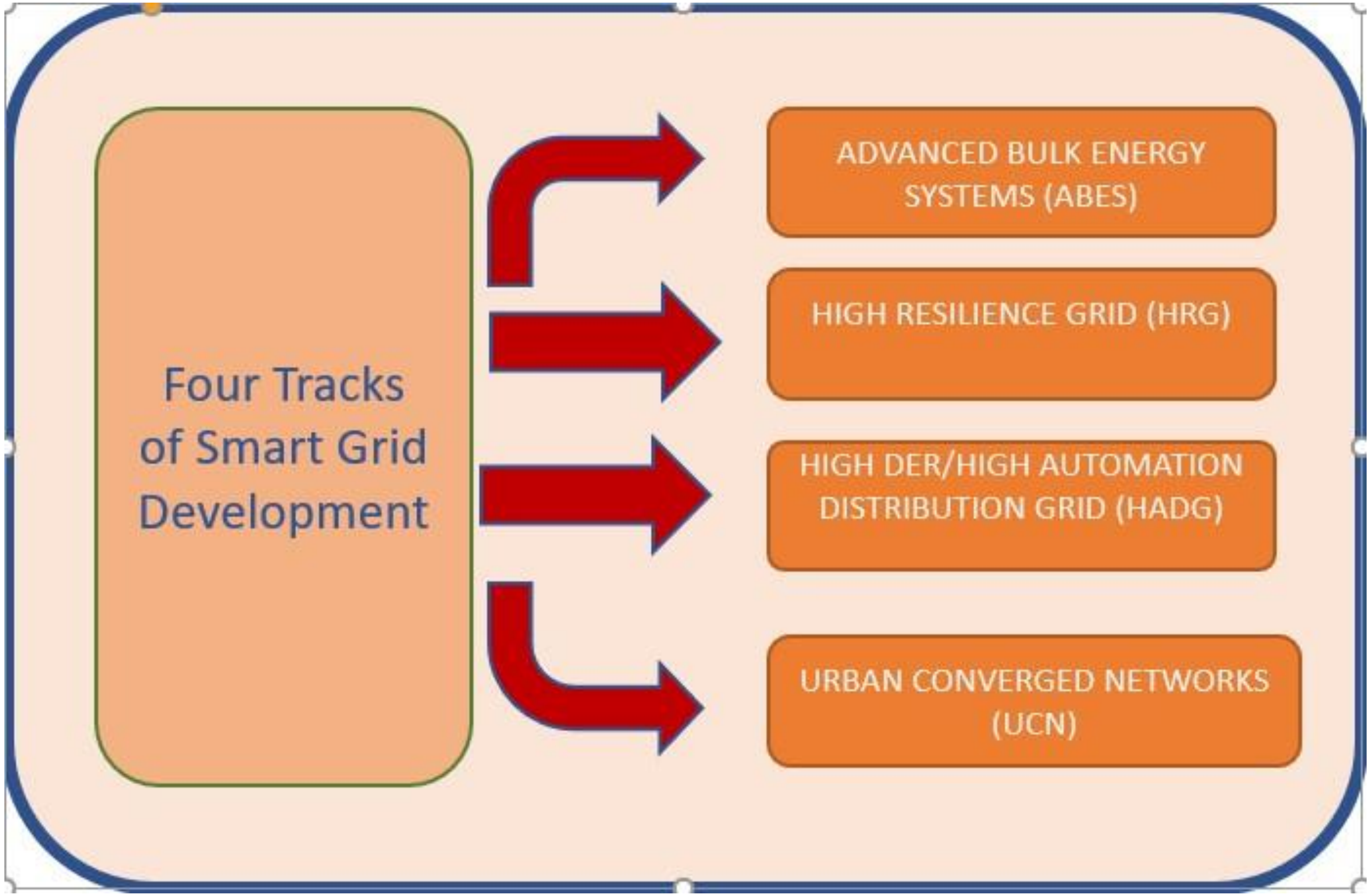
Developing self healing microgrid clusters for resiliency

HIGH RESILIENCE GRID (HRG)

- As the goods and services that are inputs to resilience in the electric power sector are also in demand by other critical infrastructure sectors (telecommunications, transportation, natural gas, water, sewer) entrepreneurial organizations may seek to develop **platforms that can deliver resilience-enhancing** resources and capabilities to a wide variety of customers.

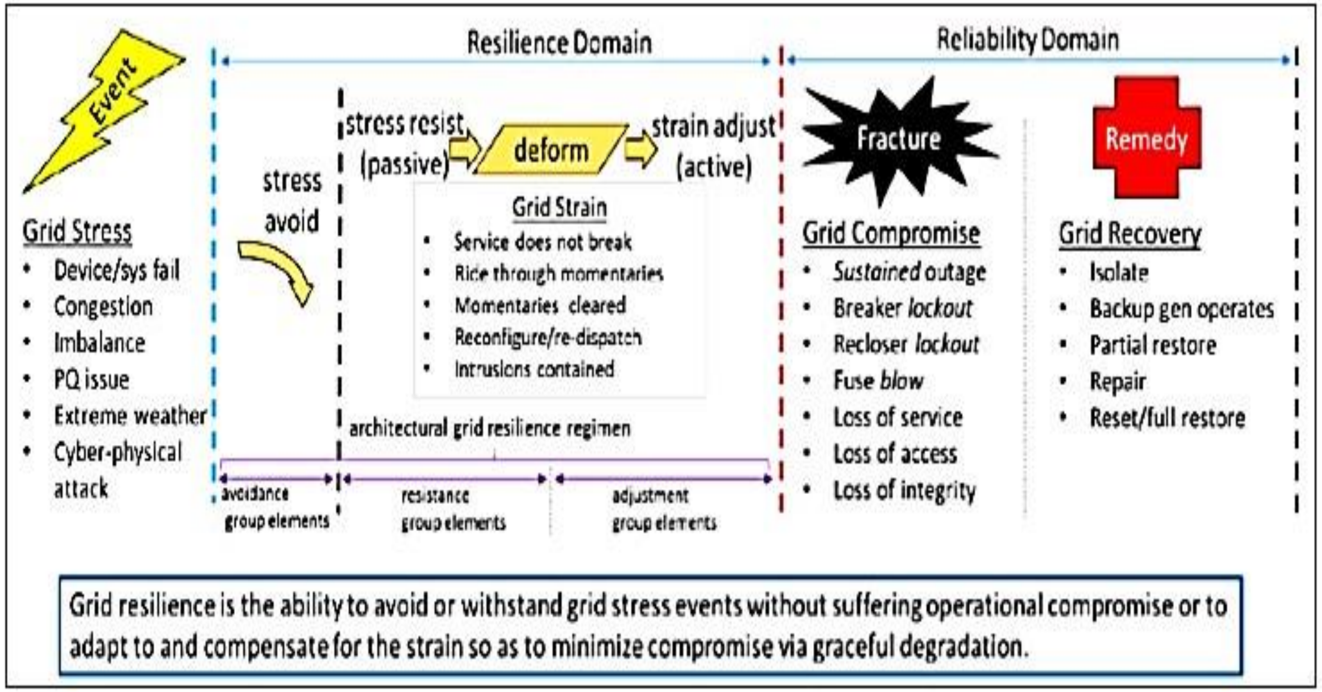
- Such a development might constitute a force **for network convergence** between high resilience) and urban converged networks architecture.

- Governmental and private sector organizations that monitor and mitigate **cyber-physical threats** to critical infrastructure are likely to factor more prominently in the electric sector's ecosystem going forward



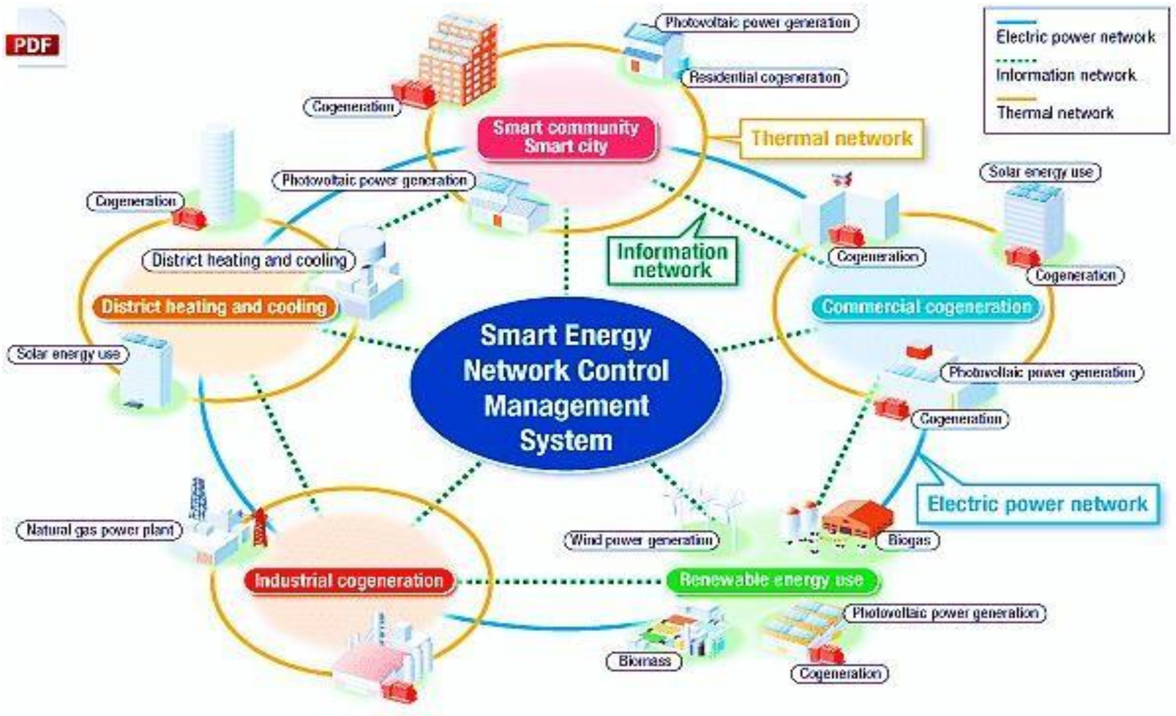
DIFFERENCES OF RESILIENCE FROM RELIABILITY

•**Resilience is defined** as the ability to avoid and maintain service against a situation that disrupts the integrity of the network by adapting in a planned manner so that it can cause adverse effects from events.
•**Resilience is** more likely to face threats that are **"low probability but high impact"** compared to reliability which is a response measure to **"high probability but low impact"**
•Resilience is the work of network managers with customers and other stakeholders, while reliability is the character of the network and its managers jaringan



Source: JD Taft, 2017

Figure 1. Resilience and Reliability Domains



Source: osakagas.co.jp

Internal Market for Resiliency

TABLE 2: INTEROPERABILITY AND STRATEGIES FOR RESILIENCE

Acronym	Resilience Strategy	Interoperability Value Proposition	Potential Benefits from Interoperability
AMS	Asset Management Systems	++	Lower asset management costs as constituent devices are easier to integrate into network.
OMS	Outage Management Systems	+	Improved information sharing during a disruption. Coordination of DER service dispatch with utility response efforts.
MAG	Mutual Assistance Group	~	Improved communications and coordination capabilities among outage response workers.
EIM	Energy Imbalance Market	++	Expand the footprint of the EIM to include additional compatible resources for balancing.
DER	Distributed Energy Resources	++	Facilitate the marketing of new electricity-related services by small grid-edge resources.
IED	Intelligent Electronic Devices	+	Improved system monitoring and contingency response.
TMS	Tree Management Services	~	Improved management through monitoring and communication of foliage encroachment on delivery assets.

Asset Management Systems (AMS) are software suites that can support the decision-making process of firms operating large technology portfolios. The services provided by AMS can include asset supervision and asset performance, through which the operating condition and economic performance of grid components can be evaluated, respectively

Outage Management Systems (OMS) are of growing importance to electric utilities as extreme weather events lead to increasingly large sets of customers losing power, sometimes for long periods of time. Modern OMS allow for optimized response to outages through the rapid identification of problem locations, reducing the number of truck rolls necessary to get the grid back up and running.

Mutual Assistance Groups (MAG) are entered by utilities around the country and organized by region so that when extreme events require restoration actions that are beyond the capacity of any individual firm to respond, other firms can lend aid and utilize idle human and capital resources.

EIM can help provide efficiently dispatched alternatives to load curtailment.

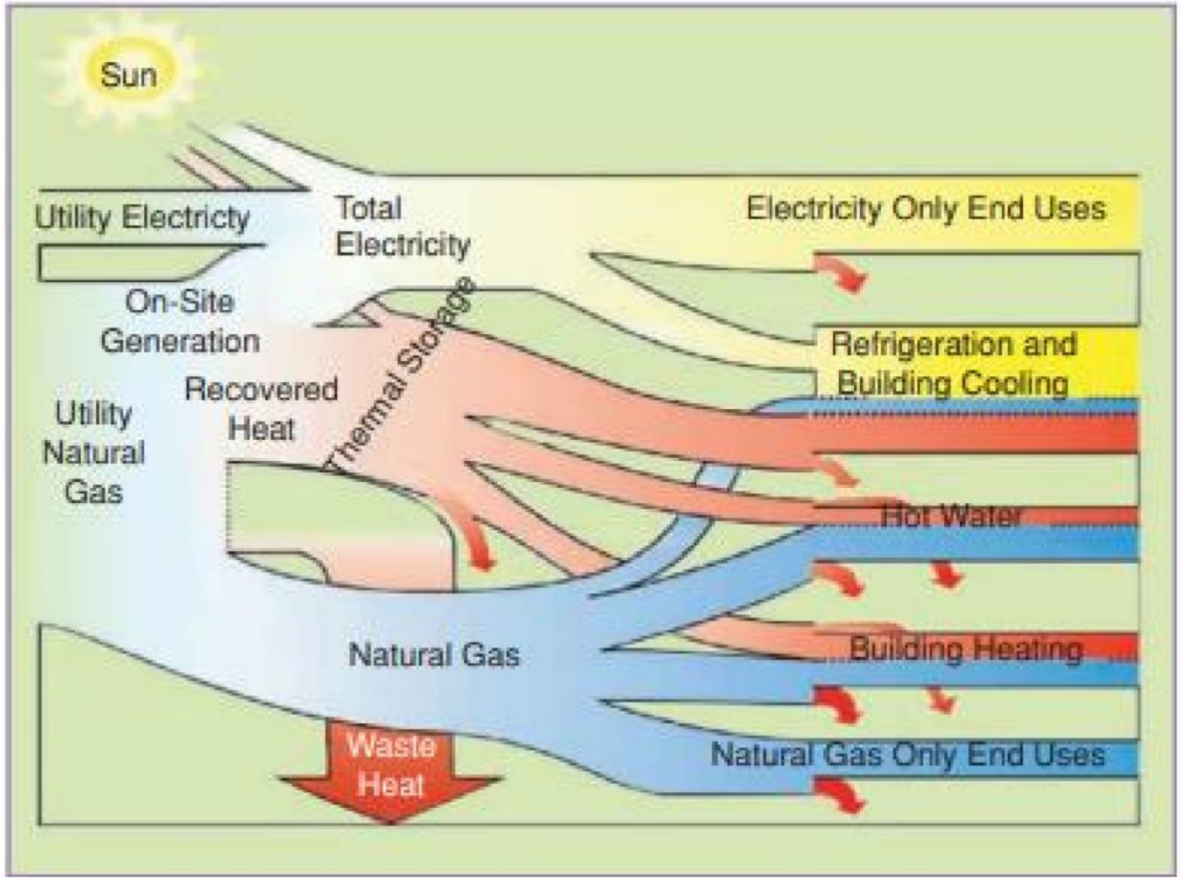
Tree Management Services (TMS) are not new, but preventative care to minimize the threat to transmission and distribution assets from plant debris can go a long way towards improving resilience. Furthermore, preventative efforts have the advantage of being carried out on a consistent and predictable schedule, avoiding the cost of overtime and rush that is endemic after a hazard such as a hurricane

EXTERNAL MARKETS FOR RESILIENCE

- Electricity customers cannot directly control the level of resilience that they enjoy in their service. Organizations that need a higher level of resilience that is may make parallel investments in behind-the-meter (BTM) devices.
- Two implications of this pattern of parallel expenditure :
- First, the cost structures of these redundant generating and storage options generally do not enjoy sufficient economies of scale to make back-up generation not otherwise utilized fully competitive with utility supplied electricity.
- Second, these BTM investments are likely to have low capacity utilization rates due to the incomplete integration of their operation with the rest of the grid and unable to give full benefit of DER.
- These two issues are most pronounced for residential and small commercial customers. Some commercial and industrial entities have had relative success in deploying DER for on-site power production that also improves resilience.
- Industrial customers may buy onsite generation like fuel cells or PV with battery storage for the improved power quality and the ability to manage their reactive power impacts on the grid. In such cases, the additional benefit that comes from having a redundant supply source may be ancillary to the investment decision.
- While all recipients would generally approve of improved service quality, there is likely to be considerable heterogeneity in their willingness to compensate suppliers for additional resilience. As the customers making these parallel investments in resilient supply tend to be large consumers of electric energy and related services, their continued participation in electricity markets is important to the business prospects of conventional utilities and emergent firms.
- Aligning incentives of individual investments with those of legacy grid operators could mitigate the potential for expenditures on underutilized equipment and improve the implementation of the technologies that end up employed.

Source: Chris Marnay & Ryan Firestone, 2007

URBAN CONVERGED NETWORKS (UCN)



A. CONVERGENCE OF ELECTRICITY AND GAS NETWORKS

A primary component of the UCN architecture track is converged gas and electric systems. The low cost and modularity of natural gas generating equipment, along with technological advancements that have enabled the 'fracking boom' and brought to market large quantities of inexpensive natural gas, has displaced costlier generating resources in the economic optimization of the grid (often termed the 'dispatch stack'). This, in turn, has increased the exposure of electricity markets to developments in natural gas markets.

B. CONVERGENCE OF ELECTRICITY AND TRANSPORTATION NETWORKS

A key affinity between electricity and transportation networks is the near universality of their use by individuals and organizations. Both systems are geographically dispersed and the large customer bases of electric utilities and transportation services imply that opportunities from convergence are likely to impact most Americans.100 Decades of accumulative technological innovation and a desire to reduce vehicle emissions have enabled and encouraged increased electrification of transport fleets, rebuilding the interdependencies between the electric grid and transportation systems.101 Therefore, opportunities for performance improvements through the convergence of communications infrastructure used by the two networks are legion and small improvements may be leveraged to effect large changes in agent coordination and system performance.

The potential challenges of serving EV loads with the existing grid are real, but the opportunities to learn from these systems integration challenges and derive operational and economic improvements from the accompanying growth in load, revenue, and observability will be a net benefit to the electric power sector

Challenges ahead:

- Deployment of Smart meter as foundation of two way communication which is necessary to achieve flexibility.
- Investment
- Business model
- Regulatory on ownership of asset; of data privacy;
- Mayor policy of the new role of Indonesia in the future energy industry landscape. (Can we treat electricity as commodity which also open for export market ?)
- Roadmap of a new structure in Electricity Sector which depicts a larger role of private investment, the adaptation of new technology, the new players such as aggregator/integrator, prosumer etc
- Technical regulatory on inception of distributed generators, interconnectivity & interoperability; the operation of energy storage; ancillary services etc.
- Private Investment is required, but what is the acceptable business model that both comply with existing Law and Regulation and give a reasonable security of return to the investor.
- Sandboxing regulation for technology implementation.
- Modernization of Power System and Distribution Control in Jawa Bali, Sumatera, Kalimantan

Opportunities for Japan investment

- Active mediation between Japanese Industry in Indonesia to PLN and Government for example through JICA or Jakarta Japan's club to be able to obtain firsthand information of what is happening in Indonesia's energy sector.
- Investment in Renewable Generation to protect Japan investment in industries from possibility of carbon border tax implemented by export market countries. This can be done by individual industry or by the Industrial Estate.
- Indonesia require a vast investment to meet their green energy need, but potentially it also has potential for export of renewable energy to East Asia and ASEAN market.
- Introducing new technology such as green hydrogen and ammonia production to decarbonize transport sector while at the same time provide energy storage for electricity.

Japan can develop a hydrogen industry in Indonesia and provide market as an investor and offtaker

CONCLUDING REMARKS

- Sensor devices industry. Many sensors is required in the further development of smart grid and customer digitalization need. Smart home appliances that can be monitored and control by home-automation hub

1. The current energy transition program in Indonesia has yet to produce an substantial growth of Intermittent Renewable Distributed generators ; as such it is foreseen to be the main driver of Smart Grid in Indonesia.
2. The rapid development of EV also expected to be another major driver of smart grid
3. PLN 's internal program of replacing existing scattered diesel generation with hybrid Solar+Storage+base load generators is also considered to be major driver of a breakthrough.
4. Policy, Regulatory and investment is seen as a major challenge that need a short term solution. Inconsistencies of regulatory in the past has increase the level of investment risk which turn into high cost of service.
5. Smart Metering, followed by technologies that required to smoothen the impact of high penetration of PV Rooftop is expected to be in need in the near future while PV farm, on-shore and off shore wind is seen in the next 5 years.
6. The need of inter-island connectivity is seen at the horizon; PEKIK NUSANTARA will require undersea cables, HVDC Converter/Inverter, Switchgears etc. Positioning Indonesia to be exporter to East Asia of Renewable Energy will

ensure the rapid development of RE Large Scale projects which allow Indonesia to achieve Net Zero Emission in line with other significant Global Economy player.

7. Japan being a long term partner in economic development of Indonesia is at advantage to provide investment as well as off-taking the product of Renewable Energy and development of smart grid in Indonesia.

Thank You

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