Ancillary Services and Technologies; Opportunities for Thailand's Power Grids

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Ancillary Service Review

Ancillary Services

*IRENA Definition

Frequency Regulation

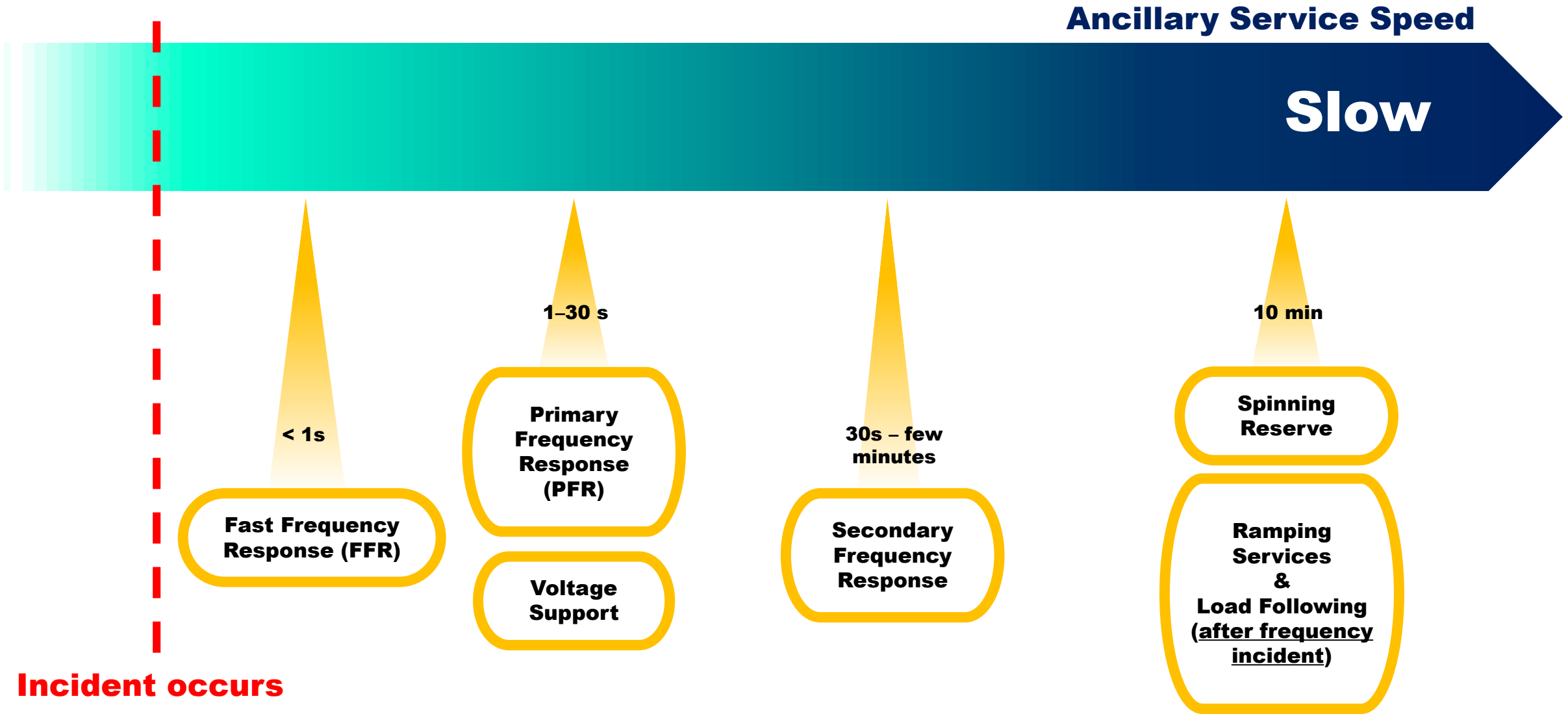
- **Primary regulation**
  - ❖ Automatic Local Regulation
  - ❖ responds in sub-second to seconds
  - ❖ Fast Frequency Response
  - ❖ Primary Frequency Response
- **Secondary regulation**
  - ❖ Automatic Regional Local Regulation
  - ❖ Use Automatic Generation Control (AGC)
  - ❖ responds in < 15 minutes
- **Tertiary regulation**
  - ❖ Manual Regulation by generating units and dispatched by System Operator
  - ❖ responds in > 15 minutes

Non-Frequency Regulation

- **Voltage Support**
  - ❖ Injection or Reduction of Reactive Power
- **Black Start**
  - ❖ The ability to restart the grid
- **Ramping Products**
  - ❖ Fast ramping resources that can respond to large net load variations in a short time

*New Innovation

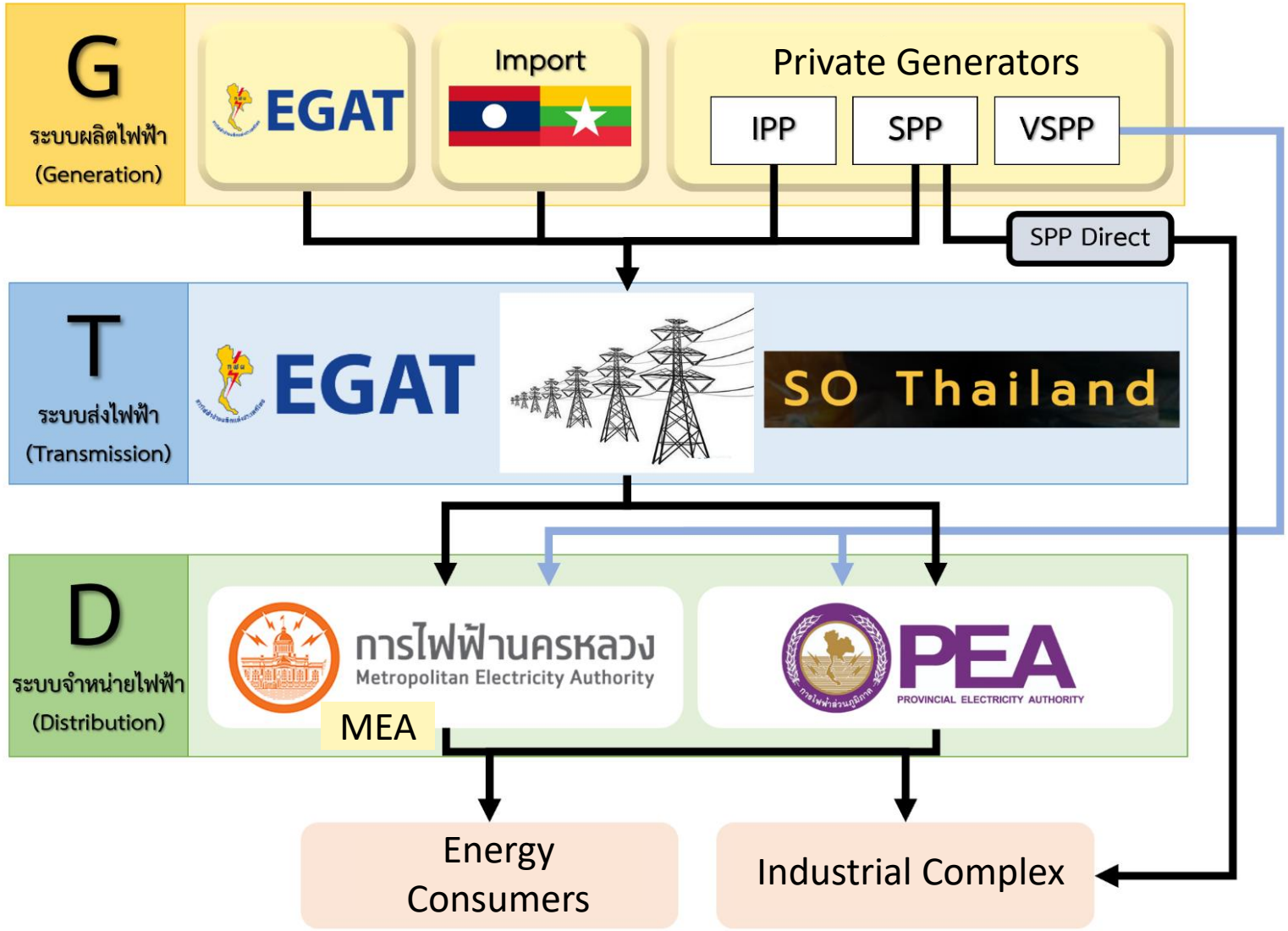
Ancillary Service Review



Ancillary Services in ESB Market

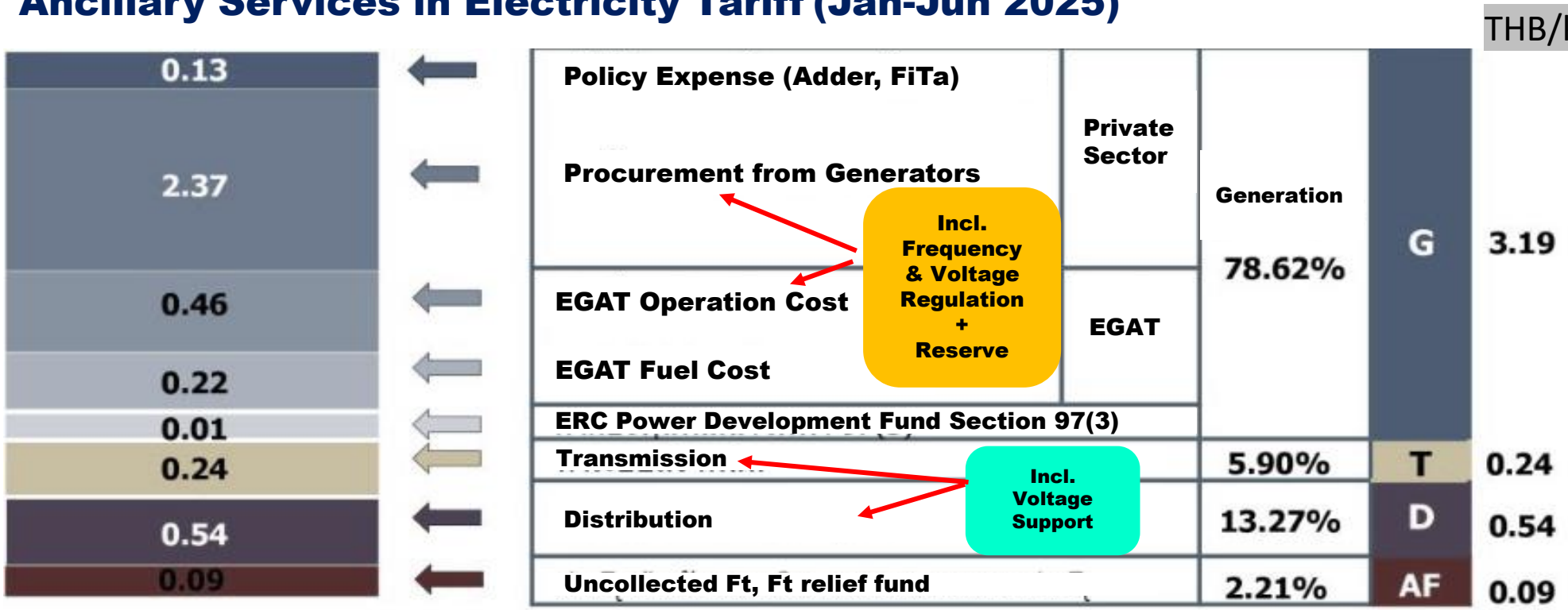
Enhanced Single Buyer (ESB) Market

- In a single-buyer system, Independent Power Producers (IPPs) and Small Power Producers (SPPs) sell electricity to the purchasing agency at fixed prices and contract durations under the PPA.
- Very Small Power Producers (VSPPs) in ESB market sell electricity to distribution system.
- All flexibility services are provided through fast-ramping power plants, such as hydropower or gas-fired plants. These services are included in the PPA.



Ancillary Services in Retail Tariff

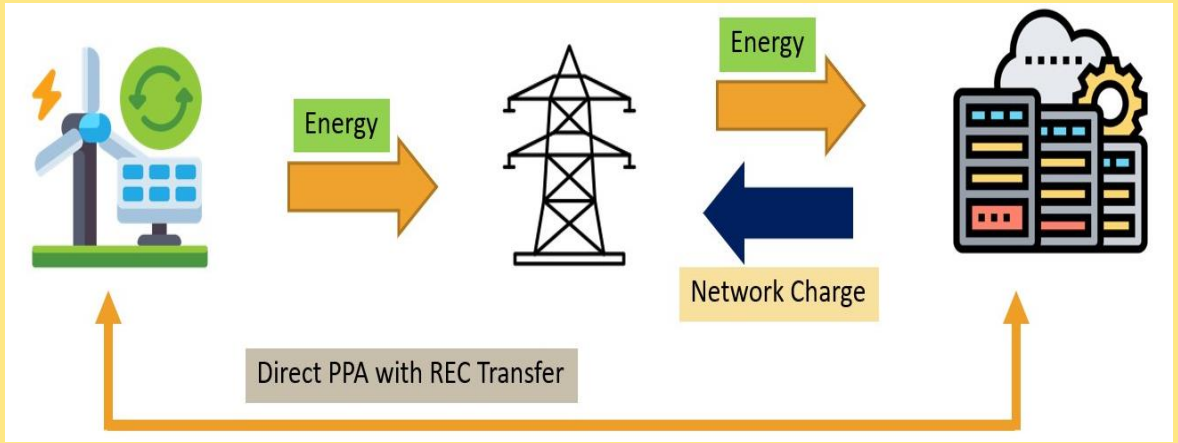
Ancillary Services in Electricity Tariff (Jan-Jun 2025)



- In Thailand, Ancillary Services (frequency and voltage regulations and reserve) are <u>included in electricity procurement agreement (PPA).</u> This is reflected in the electricity retail tariff.

Ancillary Services in TPA Tariff

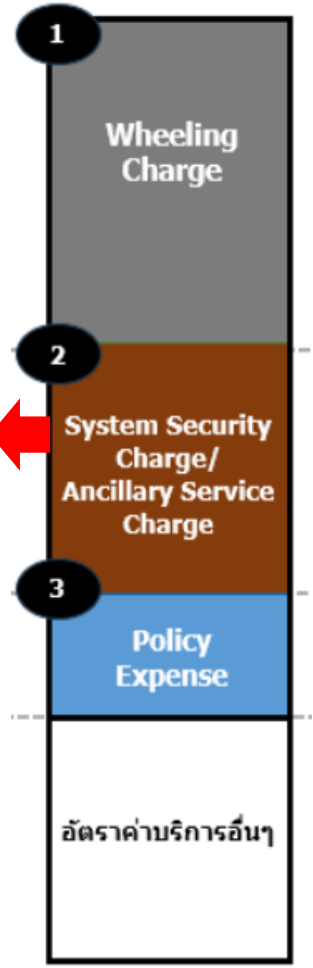
Typical DPPA structure



- TPA (Third Party Access) is a mechanism that allows power producers and consumers to access state-owned grids (EGAT, MEA, PEA).
- TPA enables DPPA (Direct PPA) business model, letting large consumers buy renewable electricity directly from producers.
- The first DPPA scheme in Thailand is a pilot project for promoting data centers, limited to 2,000 MW of RE supply.

Draft TPA tariff structure (Hearing Document from 27 Oct – 10 Nov 2025)

System Security Charge/ Ancillary Service Charge	Tariff (THB/kWh)
1) Reserve, Back up, Spinning Reserve	0.2919
2) Voltage Regulation	0.0363
3) Frequency Regulation	0.1697
4) Black Start	-
Total	0.4978



Ancillary Services in the draft PDP 2024

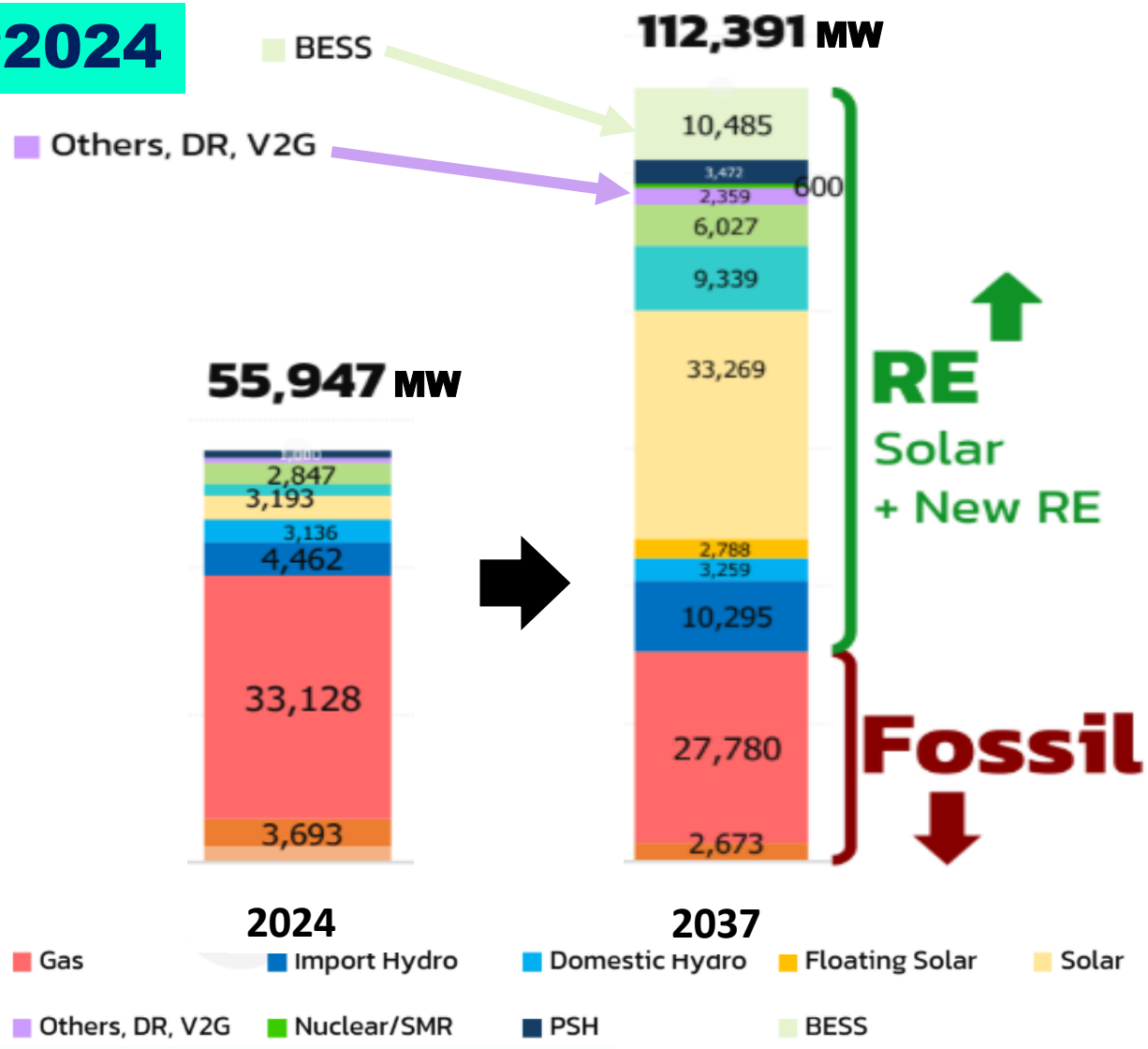
Vehicle to Grid (V2G)

- V2G (Vehicle to Grid) enables Electric Vehicles (EVs) to act as Distributed Energy Resources (DERs), allowing aggregated fleets to participate in demand response programs.
- Thailand's draft PDP2024 sets a target of 2,359 MW for combined Demand Response (DR) and Vehicle-to-Grid (V2G) programs.

Battery Energy Storage System (BESS)

- Battery Energy Storage Systems (BESSs) have become increasingly central to modern power system stability because of their ability to respond within milliseconds and deliver both active and reactive power.
- Thailand's draft PDP2024 sets a target of 10,485 MW for BESS.

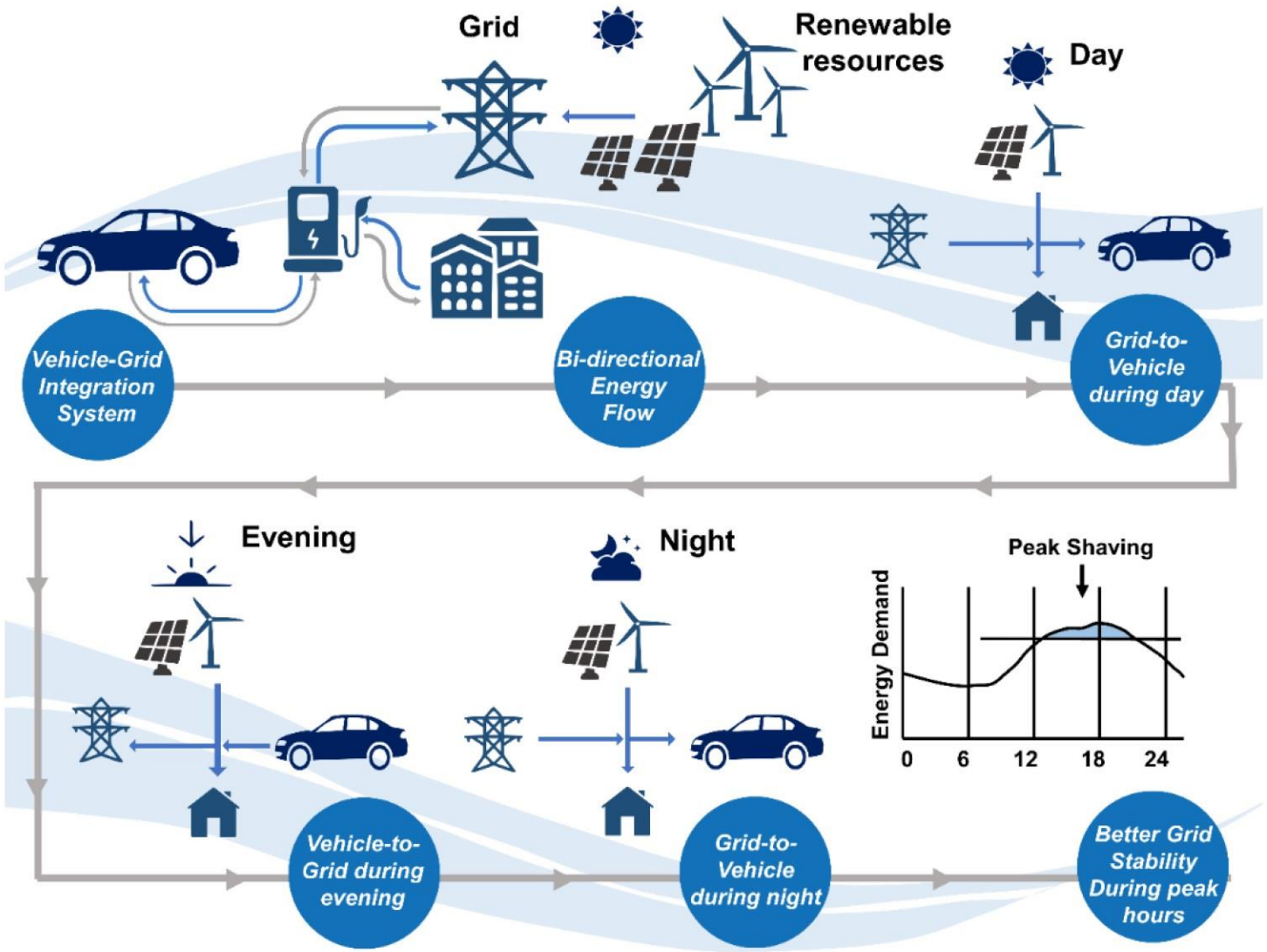
Draft PDP2024



Emerging Ancillary Services

Vehicle to Grid (V2G)

- The pilot project by EGAT focuses on testing Vehicle-to-Grid (V2G) and Virtual Power Plant (VPP) technologies within Thailand's existing electricity system in the ERC Sandbox.
- V2G can benefit both consumers and energy businesses.
  - Consumers gain potential new revenue streams, improved energy management, and backup power options.
  - Energy businesses gain system reliability support through ancillary services.
- EVs can absorb or supply small amounts of power very quickly in response to frequency deviations on the grid.

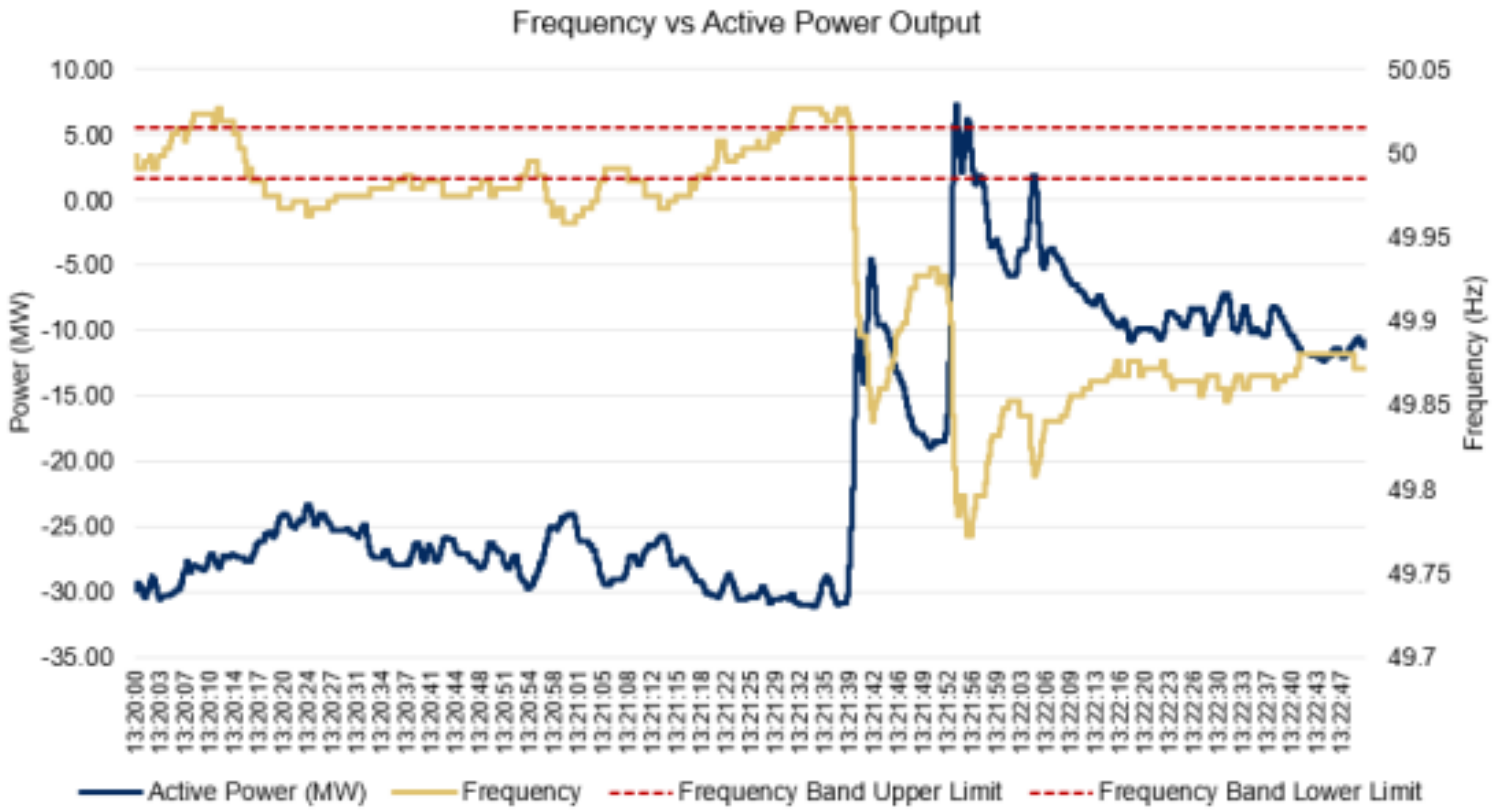


Emerging Ancillary Services

Battery Energy Storage System (BESS)

- Battery Energy Storage Systems (BESSs) have become central to modern power system stability because of their abilities to
  - respond within milliseconds
  - deliver both active and reactive power
- In fast frequency response, a battery system can inject power almost instantaneously.
- For voltage support, modern battery systems use power electronics to deliver finely controlled reactive power.
- In black start service, batteries provide power that does not rely on external voltage or mechanical prime movers.

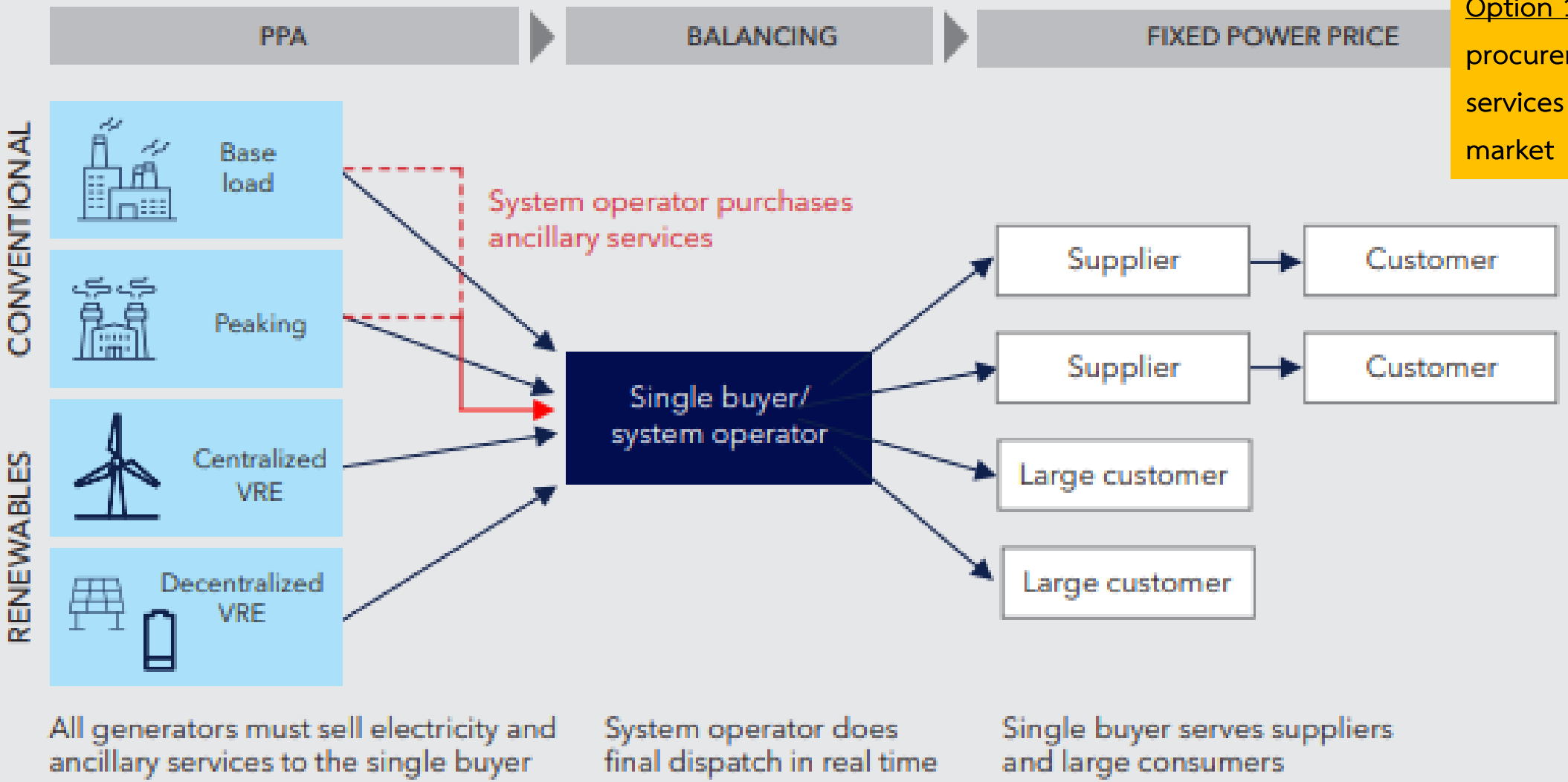
Hornsdale Power Reserve (HPR) : According to Neoen's HPR Operations Report (first half of 2024), the battery uses a "virtual machine mode" (VMM) to mimic synchronous inertia and responded very quickly to a frequency event.



Hornsdale Power Reserve Expansion HPR Operations Report – H1 2024

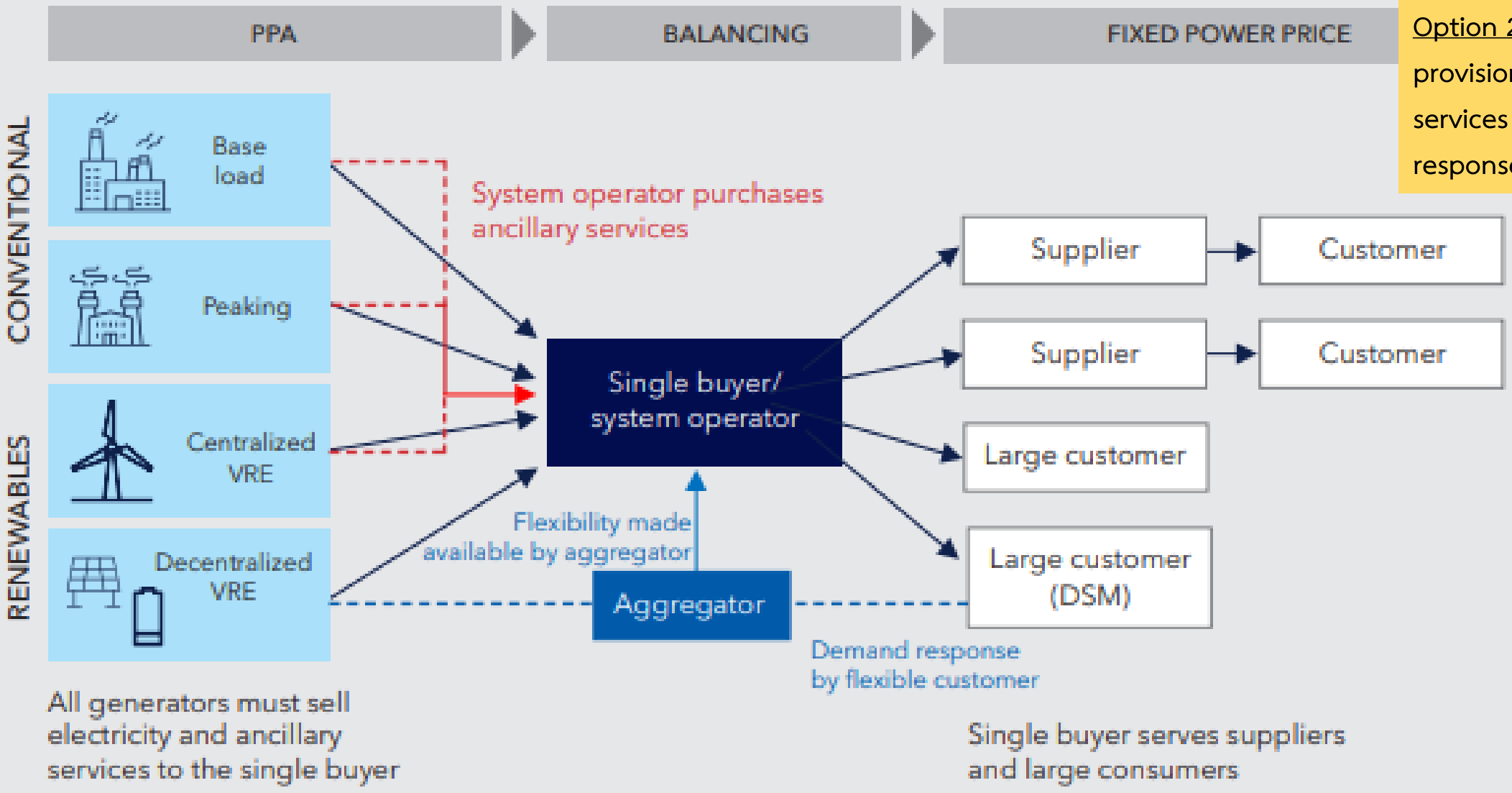
Ancillary Services in Market transition from ESB

Option 1: Separate procurement of ancillary services in a single buyer market



RENEWABLE ENERGY INTEGRATION AND BALANCING IN SINGLE BUYER ELECTRICITY MARKETS by DNV

Ancillary Services in Market transition from ESB



Option 2: Additional provision of ancillary services by demand response and aggregators

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Ancillary Services and Market Challenges

Transition goal to Ancillary Service Market

REGULATORY REQUIREMENTS

Retail market:

Allowing DERs to participate in ancillary service markets

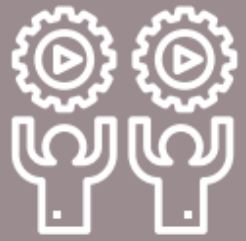
Wholesale market:

- Regulation for new ancillary service products.
- recognition of the VRE services for grid stability

Distribution & Transmission:

- Roadmap for integration of VRE into the grid, encompassing role of ancillary service providers and the design of dedicated ancillary service markets
- Permission for DSOs to procure ancillary services
- Strong co-operation frameworks between DSOs, TSOs and ancillary service providers

STAKEHOLDER ROLES AND RESPONSIBILITIES



TSOs:

- Evaluate new ancillary services to improve VRE integration
- Pilot new ancillary service products
- Update grid codes and system services procurement mechanisms

DSOs:

- Forecast ancillary services from DERs using historical data and weather predictions
- Securely store and share grid data with TSOs and service providers

Ancillary Services Providers:

- Participate in ancillary service markets where available
- Comply with regulations and technical requirements, including data exchange with DSOs and TSOs

Regulator:

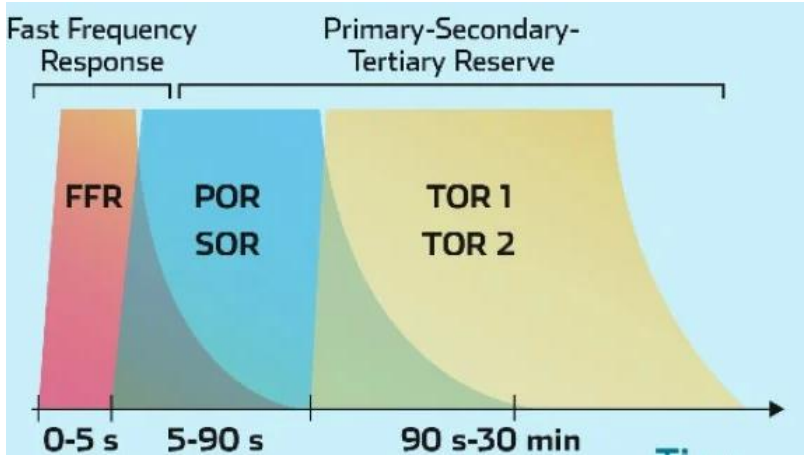
Defining and mandating new ancillary service products in collaboration with TSOs and DSOs

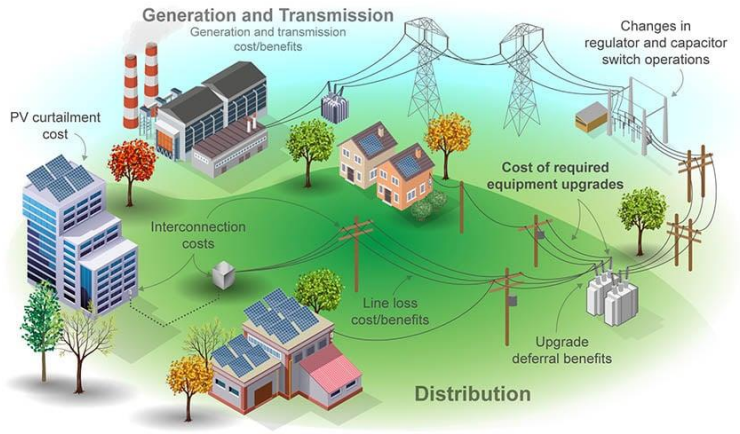
From report:

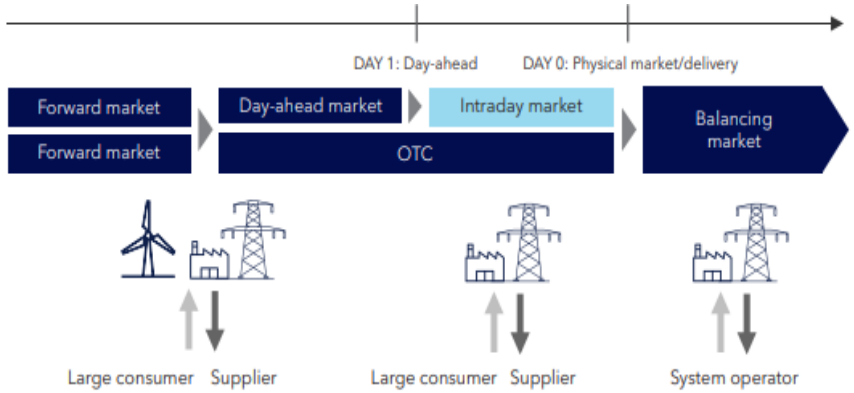
- INNOVATIVE ANCILLARY SERVICES INNOVATION LANDSCAPE BRIEF

Ancillary Services and Market Challenges

Challenges in Transition from Utility owned services to Ancillary Service Market







procurement and product design

- In single-buyer systems, ancillary services come implicitly from large controllable thermal plants.
- In market-based systems, these services must be explicitly defined, measured, and paid for, which requires new service specifications, performance metrics, and settlement rules.

Visibility & aggregation of distributed resources

- In a single-buyer system, the utility directly sees and controls most generators.
- In a market, distributed resources such as rooftop solar, batteries, and electric vehicles require aggregation, telemetry, and clear participation rules.

institutional and regulatory readiness

- TSOs, regulators, and market operators must set rules for co-optimizing energy and ancillary services and paying for new services like synthetic inertia. Many countries moving from single-buyer systems lack the experience and frameworks to implement such reforms.

From report:

- Essential System Services in Grids Dominated by Renewable Energy
- Frequency reserves and inertia in the transition to future electricity systems

Frequency Response with Ultracapacitors

Advanced Hosting Capacity Analysis | Solar Market Research & Analysis | NREL

RENEWABLE ENERGY INTEGRATION AND BALANCING IN SINGLE BUYER ELECTRICITY MARKETS by DMV

THANK YOU