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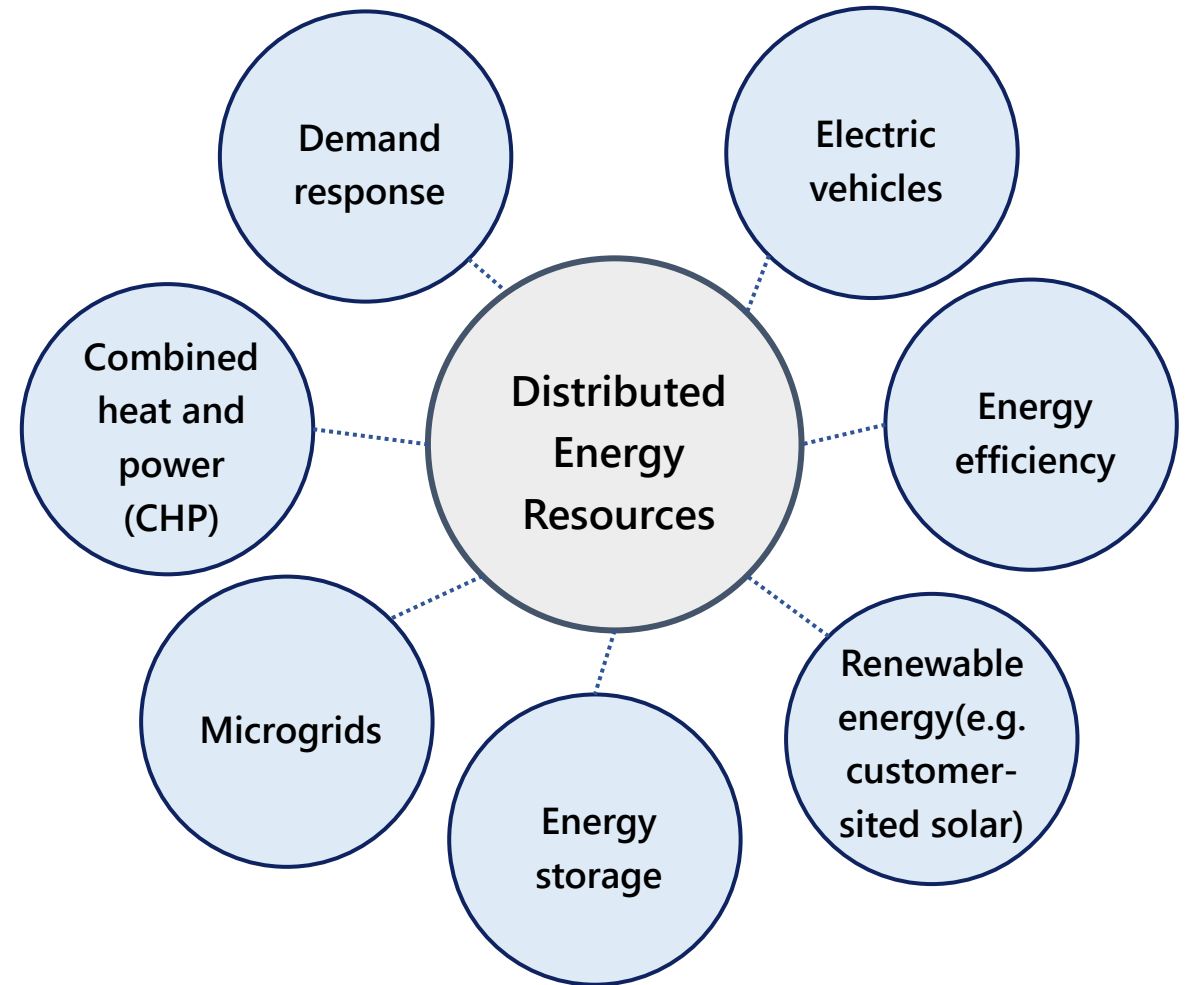
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- The increasing deployment of distributed energy resources (DERs) represents a pivotal shift in how energy is generated, distributed, and consumed.
- The integration of DERs into existing energy markets and grid systems requires a comprehensive approach.
- This presentation provides a high-level review of **tariff design, key regulatory frameworks, and market-based mechanisms** that promote the adoption, and enable the full integration and optimal utilisation, of DERs.

Figure 1. Categories of Distributed Energy Resources (DERs)



Key driver of DER adoption:

1. Cost saving and economic efficiency
2. Sustainability and decarbonisation goals
3. Energy independence and resilience
4. Grid modernisation and flexibility
5. Regulatory support for DERs

Barriers to uptake and integration/optimal utilisation:

1. Regulatory uncertainty
2. Design and structure of consumption and export tariffs
3. Limited data and grid visibility
4. Grid integration challenges

1

A **shift away** from **net-metering and feed-in tariff (FiT)** mechanisms towards pricing mechanisms that fall within a **net billing** framework

Feed-in tariff

Policy and pricing mechanisms that guarantee a fixed, long-term payment (15-20 years), usually at above market rates, for each unit of electricity exported to the grid. They are set at such levels to guarantee a reasonable return on investment.

Net-metering

Net metering is a tariff structure that credits grid connected self-generating customers ("prosumers") for electricity exported to the grid at the same retail rate which the customer typically pays for the electricity. Effectively allowing the customer to "reverse their meter".

Net-billing tariff

Net billing is a pricing or billing framework. Unlike net metering, net billing always applies different energy charges for consumption and export. Export tariff is often linked to the wholesale market price, an estimate of avoided average or marginal cost, or at a preset export tariff.

Source: (i) IEA glossary website (<https://www.iea.org/glossary#F>); (ii) Pacific Gas & Electric (2025), *Net Metering*.

1

A **shift away** from **net-metering and feed-in tariff (FiT)** mechanisms towards pricing mechanisms that fall within a **net billing** framework

2

A move toward **time-of-use (ToU) based energy charges** within net billing frameworks

3

A transition away from tariffs that strongly incentivise exports, to those that **incentivise self-consumption** from DER systems

4

A **shift away** from traditional **volumetric tariffs** towards two and three-part tariffs with **higher fixed charges**, with **coincident peak** charges

5

Aggregation is proving to be an increasingly effective method for TSOs and DSOs to purchase power and services more efficiently

Examples of the strategies that have been employed globally

- 1** **Tariff design:** California
- 2** **Local flexibility markets:** United Kingdom
- 3** **Virtual power plants:** Australia

Case study 1. California - Tariff design

Example: California Public Utilities Commission (CPUC)

Key takeaway: Tariff structures must support consumption and export behaviour that aligns with the needs of the grid.

Case study 1: California

The CPUC has made significant reforms to consumption and export tariffs to improve cost distribution, enhance grid efficiency, and support the integration of DERs. This case study examines the transition from **NEM to NBTs**, emphasising the **role of ToU pricing** and **avoided-cost-based export mechanisms** in incentivising consumption and export behaviour that **aligns with grid needs**.

Evolution of tariff structure

1996

- CPUC launched a **flat-rate net metering** export compensation mechanism.

2016

- Shift towards static **ToU-based** export rates within **net metering** framework.

2023

- Shift to real-time ToU-based export rates within a **net billing** framework.

2025

- Introduction of **fixed charges** and **reduced volumetric charges**

Source: (i) [CPUC Net Energy Metering and Net Billing webpage](#); (ii) [CPUC \(2022\), Decision Revising Net energy metering tariff and subtariff](#); (iii) [CPUC Customer-Sited Renewable Energy Generation webpage](#); (iv) [Verdant Associates \(2021\), Net-energy Metering 2.0 Lookback study](#).

Key learnings

1. ToU tariffs optimise DER adoption, especially BESS, by aligning energy use with grid demand, enhancing efficiency and equity
2. Net billing is more equitable than NEM
3. Sufficient fixed charges are important in promoting equity
4. Customer resistance can be expected

Case study 2. United Kingdom – Local flexibility markets

Example: United Kingdom

Key takeaway: DERs can earn revenue for providing grid services locally, reducing the need for infrastructure upgrades and curtailment of renewable energy.

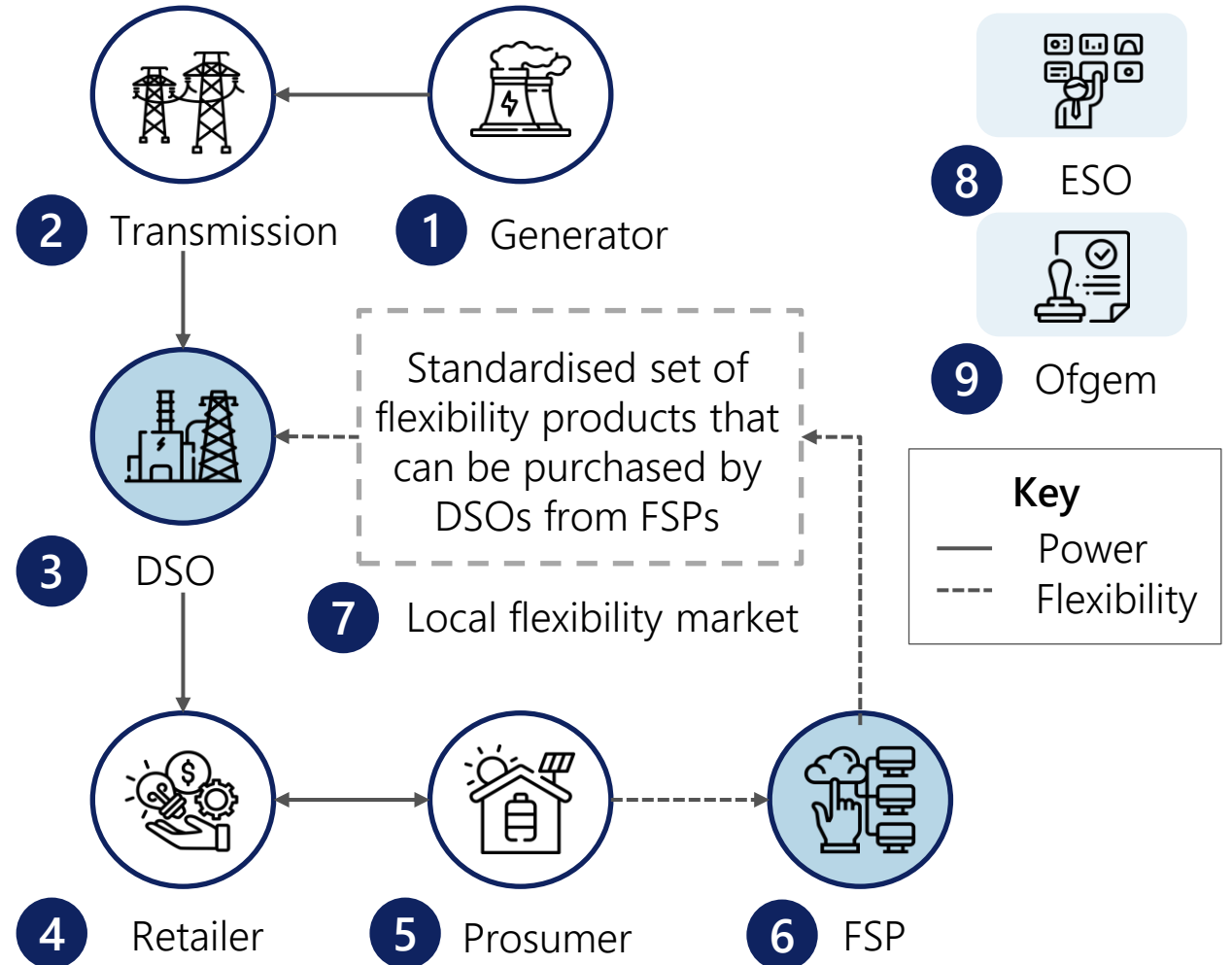
Case study 2: United Kingdom

In the UK, local flexibility markets have enabled the efficient use of DERs through aggregation, helping shift consumption and generation to manage peak demand and enhance grid reliability. While flexibility markets are still in their relative infancy, evidence from the UK demonstrates that aggregated DERs can successfully deliver flexibility services to DSOs, helping to reduce curtailment, defer network investment, and improve renewable integration at distribution level.

An overview of flexibility procurement in the distribution network

What is flexibility?

“Flexibility is the modification of generation, injection and/or consumption patterns in reaction to an external price signal to provide a service within the energy system.”



Source: (i) [Ofgem, Our role and responsibilities webpage](#); (ii) Anaya, K & Pollitt, M (2021), How to Procure Flexibility Services within the Electricity Distribution System: Lessons from an International Review of Innovation Projects; (iii) [Ofgem \(2023\), The Future of Distributed Flexibility](#).

Key enablers



Tariff design



Smart infrastructure



Regulatory support



Distribution system operator capabilities

Learnings

1. Local flexibility markets ensure the **network is used more efficiently**, unlocking value across the electricity system
2. **Smart meter infrastructure** is foundational for the local flexibility markets and system security and reliability
3. **Supportive regulation** is key to unlocking the value of distributed energy resources
4. **Price signals** must be both **cost-reflective and equitable** to scale flexibility effectively

Source: (i) [Ofgem \(2022\), RIIO-ED2 Final Determinations Overview.](#); (ii) [Piclo, Three ways RIIO ED2 will impact flexibility markets webpage.](#); (iii) [Ofgem \(2021\), RIIO-ED1 Network Performance Summary 2020-21.](#); (iv) [Nordic Energy Research \(2022\), Distributed Flexibility – Lessons learned in the Nordics.](#); (v) [UK Power Networks, Distribution System Operator \(DSO\) webpage.](#); (vi) [Elexon, What we do webpage.](#); (vii) [Ofgem \(2010\), RIIO – a new way to regulate energy networks.](#)

Case study 3. Australia – Virtual power plants

Example: Australia

Key takeaway: Aggregation enables market access for small C&I DERs and optimises dispatch value.

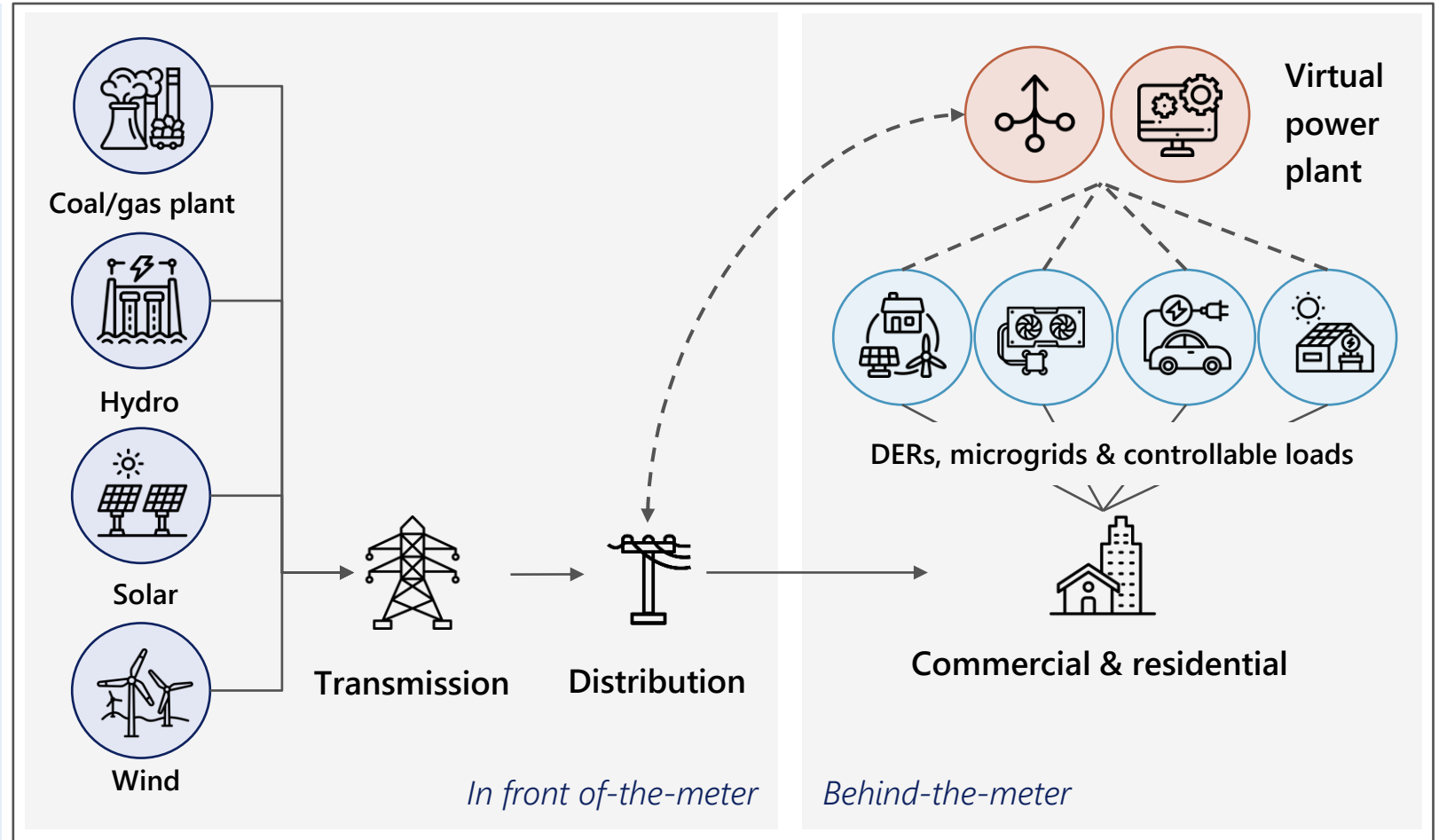
Case study 3: Australia

Australia has pioneered the development of VPPs, which aggregate DERs to create a flexible, dispatchable resource for the grid. Large users with DERs can join VPPs to offer their excess capacity to the grid, receiving payments for providing grid stability services. These initiatives reward large users who can adjust their energy consumption based on real-time price signals or provide ancillary services like frequency control and voltage regulation.

VPP at a distribution level: schematic overview

A VPP is a **network of DERs** all working together as a **single power plant**. VPPs are typically established by **aggregators** that **combine DER capacity** into a **controllable portfolio** to offer and trade flexibility and ancillary services, including:

- i. Load shifting
- ii. Peak shaving
- iii. Congestion management
- iv. Frequency control
- v. Voltage control



Source: (i) [AEMO \(2021\), AEMO NEM Virtual Power Plant Demonstrations: Knowledge sharing report #4.](#); (ii) [Government of South Australia, South Australia's Virtual Power Plant webpage.](#)

Project findings

During the VPP Demonstrations Project, VPPs **proved their ability to:**

- (i) **deliver contingency FCAS,**
- (ii) **respond dynamically to energy price signals,** and
- (iii) provide **localised network support.**

The project also enhanced AEMO's operational visibility of VPP activity, improving grid integration and system reliability.

Challenges

The AEMO encountered several challenges in the integration of VPPs, including:

- (i) **under-delivery in the FCAS market,**
- (ii) high volumes of **unscheduled price-responsive resources,**
- (iii) **inconsistent responses** by VPPs to energy price signals, and
- (iv) **distribution network constraints.**

Source: (i) [AEMO \(2021\), AEMO NEM Virtual Power Plant Demonstrations: Knowledge sharing report #4;](#) (ii) [AEMO \(2021\), Virtual Power Plant Demonstrations Consumer Insights Report.](#)
(iii) ARENA, Advanced VPP Grid Integration webpage.

Key learning

The VPP Demonstrations project offers valuable insights into both the opportunities and challenges of aggregating DERs into virtual power plants and integrating them into electricity markets.

Notably, VPPs have the potential to increase the efficiency with which DERs are used, benefitting not only the system but also consumers. However, this process is very nuanced.

Any questions?