



Harnessing DER for a Better Future

The need for DSOs

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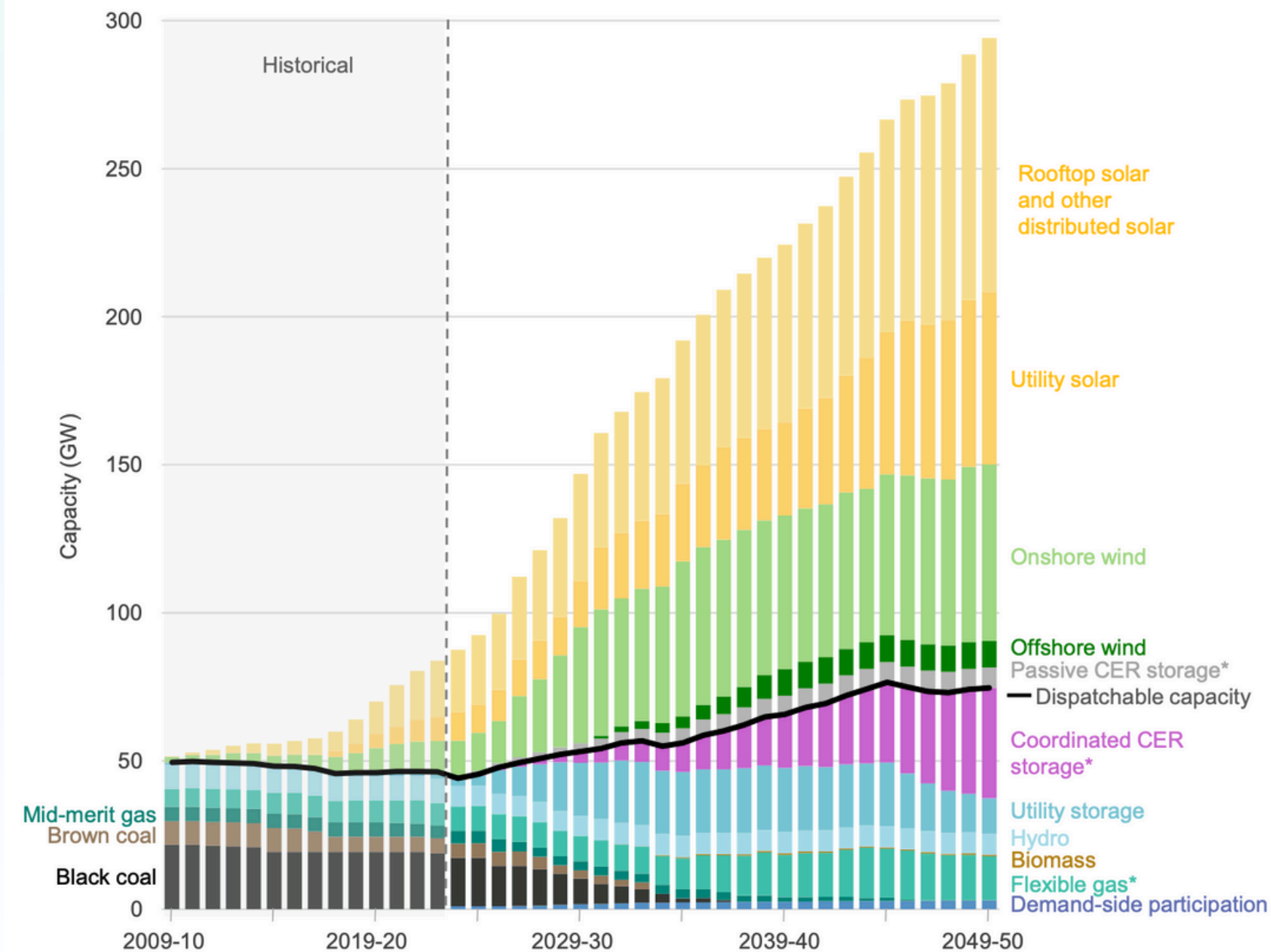
The NEM is becoming decentralised...

...but no one is in charge of all the Distributed Energy Resources.

What role should DNSPs play in a decentralised grid?

The Goal

Figure 2 Capacity, NEM (GW, 2009-10 to 2049-50, Step Change)



1

Triple grid-scale VRE by 2030, and increase it six-fold by 2050.

2

Focus grid scale generation in REZs.

3

Almost quadruple the firming capacity

4

Support forecast four-fold increase in rooftop solar capacity.

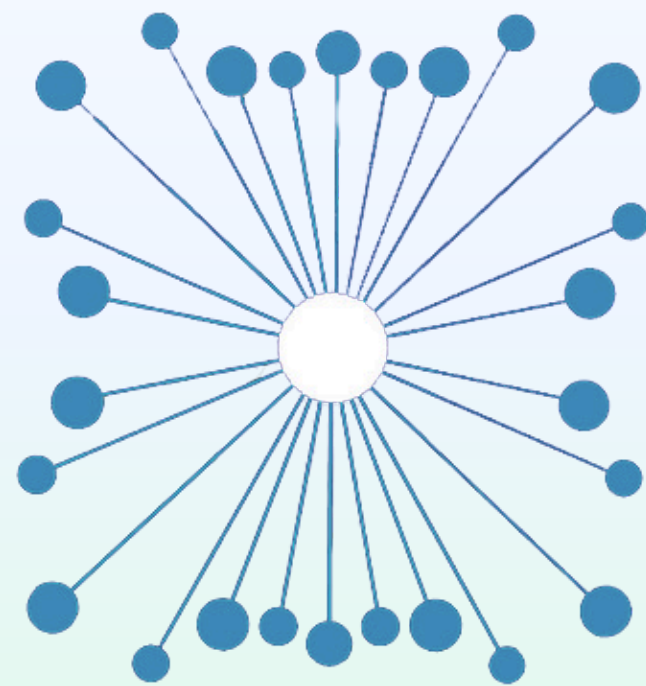
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Leverage system security services and operational approaches to ensure NEM stays reliable and secure.

The ISP **assumes** upgrades and other investments needed to enable distribution networks and their operation will occur through other mechanisms, ultimately facilitating forecasted levels of consumer energy resources and their coordination. (AEMO, 2024. Integrated System Plan)

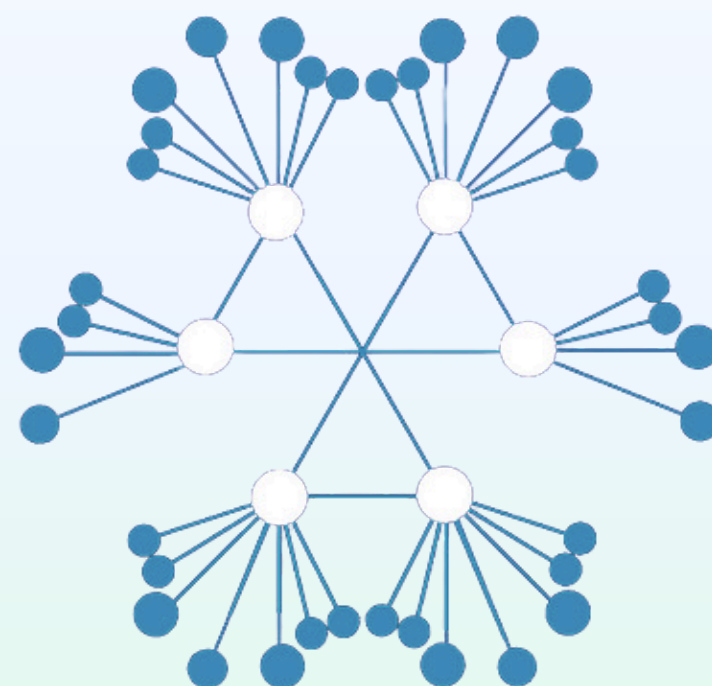
The Reality

Our energy system is undergoing a transition:



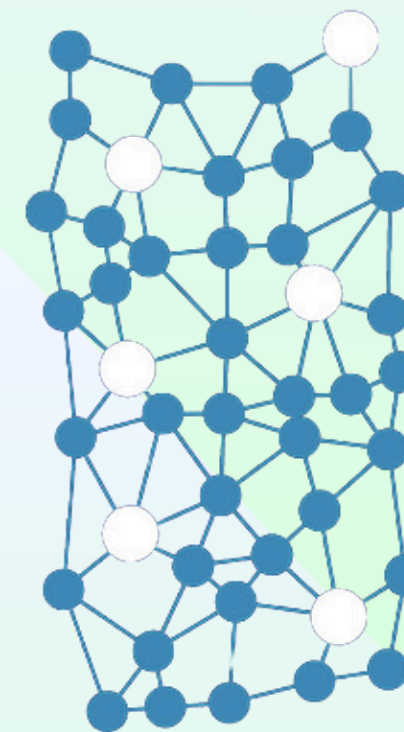
Centralized Network

All the nodes are connected
under a single authority



Decentralized Network

No single authority server
controls the nodes, they all
have individual entity



Distributed Network

Every node is independent
and interconnected with
each other

- In the past, the electricity system has been centralized, controlled by AEMO.
- Rooftop solar is creating a distributed network of generation resources.
- However, there is limited visibility and control of these distributed resources.

Obstacles

1

Lack of control over Reliability

Aside from SA and small numbers of households in QLD and VIC, DNSPs are unable to control the amount of solar being exported back to the grid.

2

Lack of control over Security

Rising DER penetration reduces system strength, inertia, and fault current but DNSPs lack the tools to manage voltage and frequency stability.

3

Lack of visibility of rooftop solar

AEMO is unable to forecast how much energy rooftop solar will generate every 5 minutes.

- AEMO works around this by estimating and using safety margins to ensure that a minimum system load is maintained.

4

Lack of local energy markets

Consumers with rooftop solar, batteries and EVs are unable to trade energy within their communities.

5

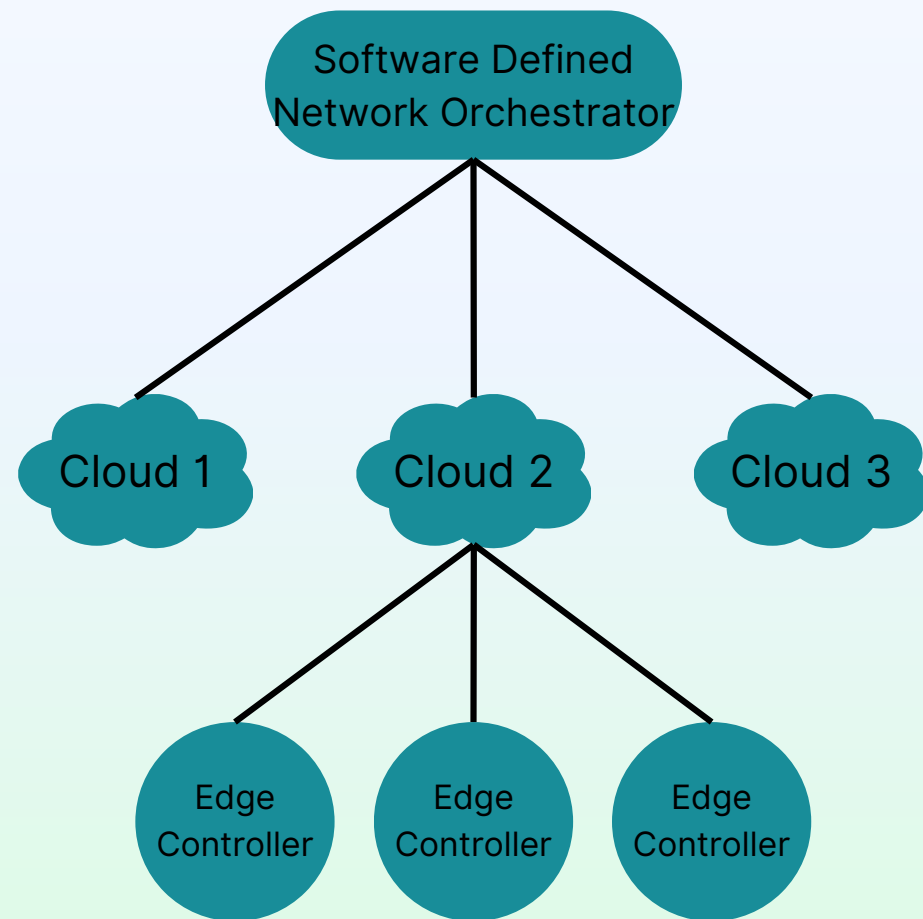
Tier bypassing

AEMO's dispatch of VPPs bypasses DNSPs leading to visibility gaps and coordination conflicts.

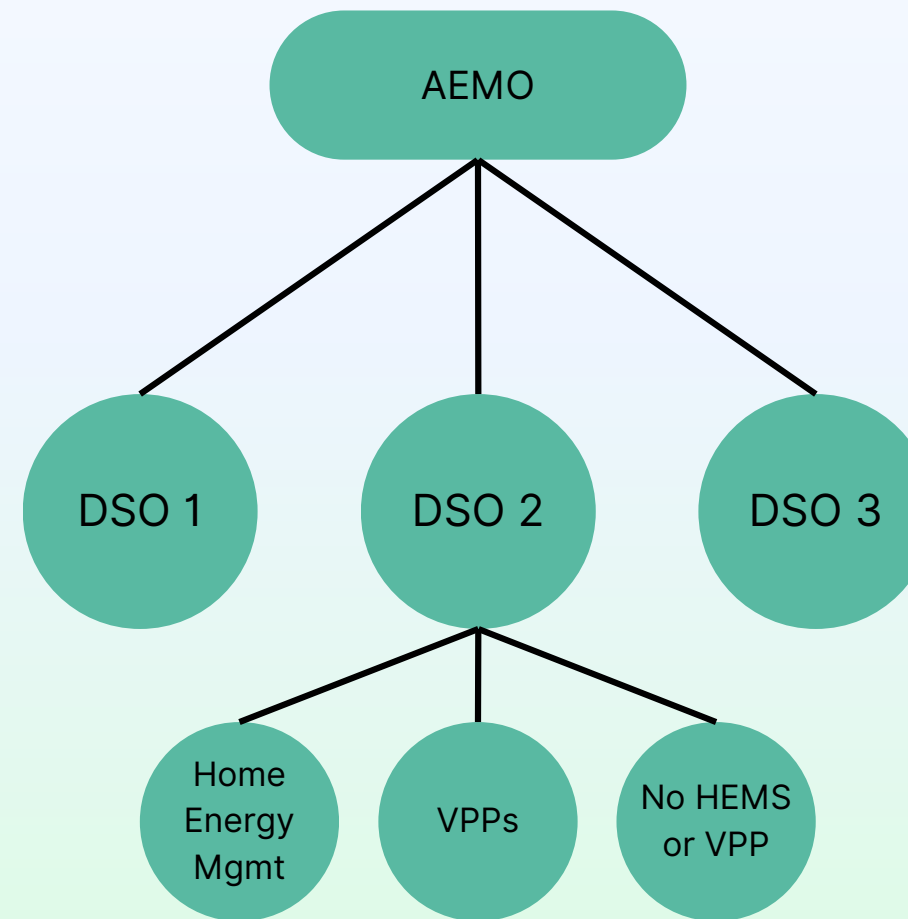
What is a Distribution Service Operator?

A Distribution Service Operator (DSO) uses a layered hierarchical topology to delegate control.

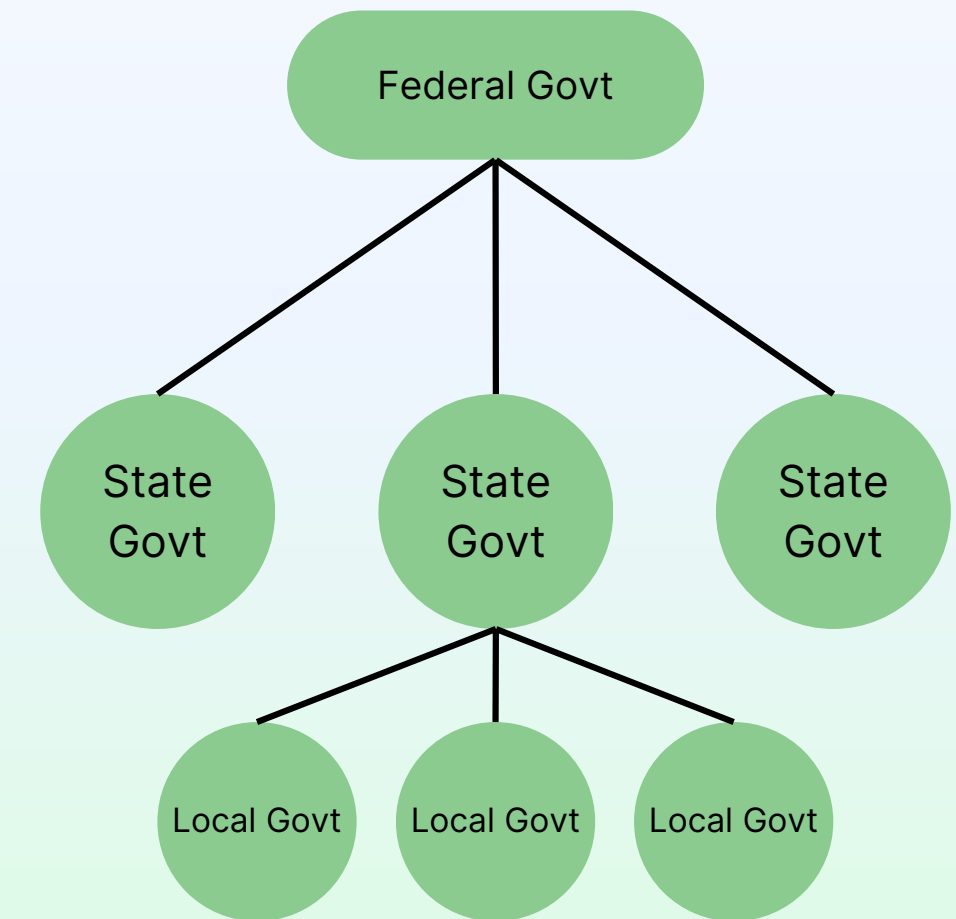
This type of topology has been used across multiple sectors to coordinate command and control, from the internet to governments.



Internet



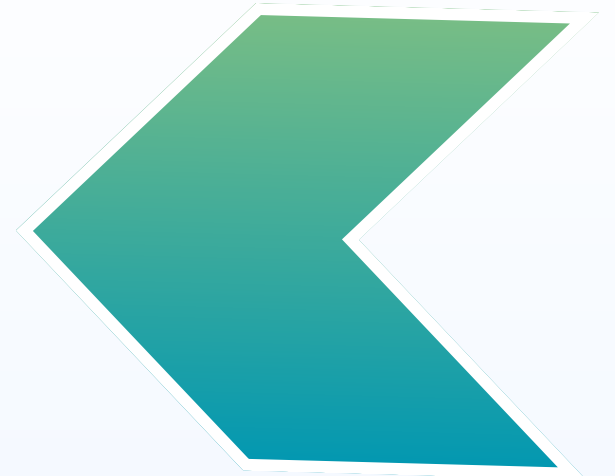
Energy



Governments

Note: The EU and UK have begun the transition to enabling DSOs. Notably, Ukraine was forced to move to a decentralised network when its transmission lines and large power stations were attacked.

Key Functions of a DSO



Opportunities

Network Resilience

Mini-grids and micro-grids could operate independently (islanded), reducing widespread outages during faults or disasters.

Improved Visibility

DSOs can view the energy export/import at each home, aggregate the numbers for each TNI and provide real time updates to AEMO.

Local Energy Markets

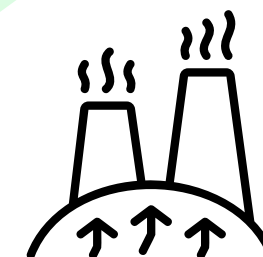
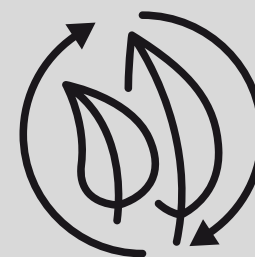
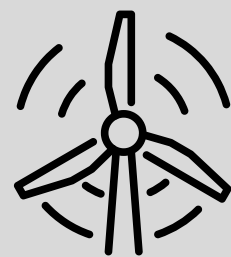
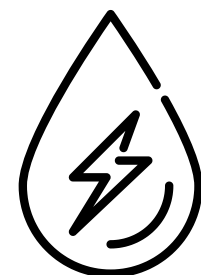
DSOs could facilitate local energy markets to allow consumers to trade energy within their own microgrid or minigrid.

Increased efficiency

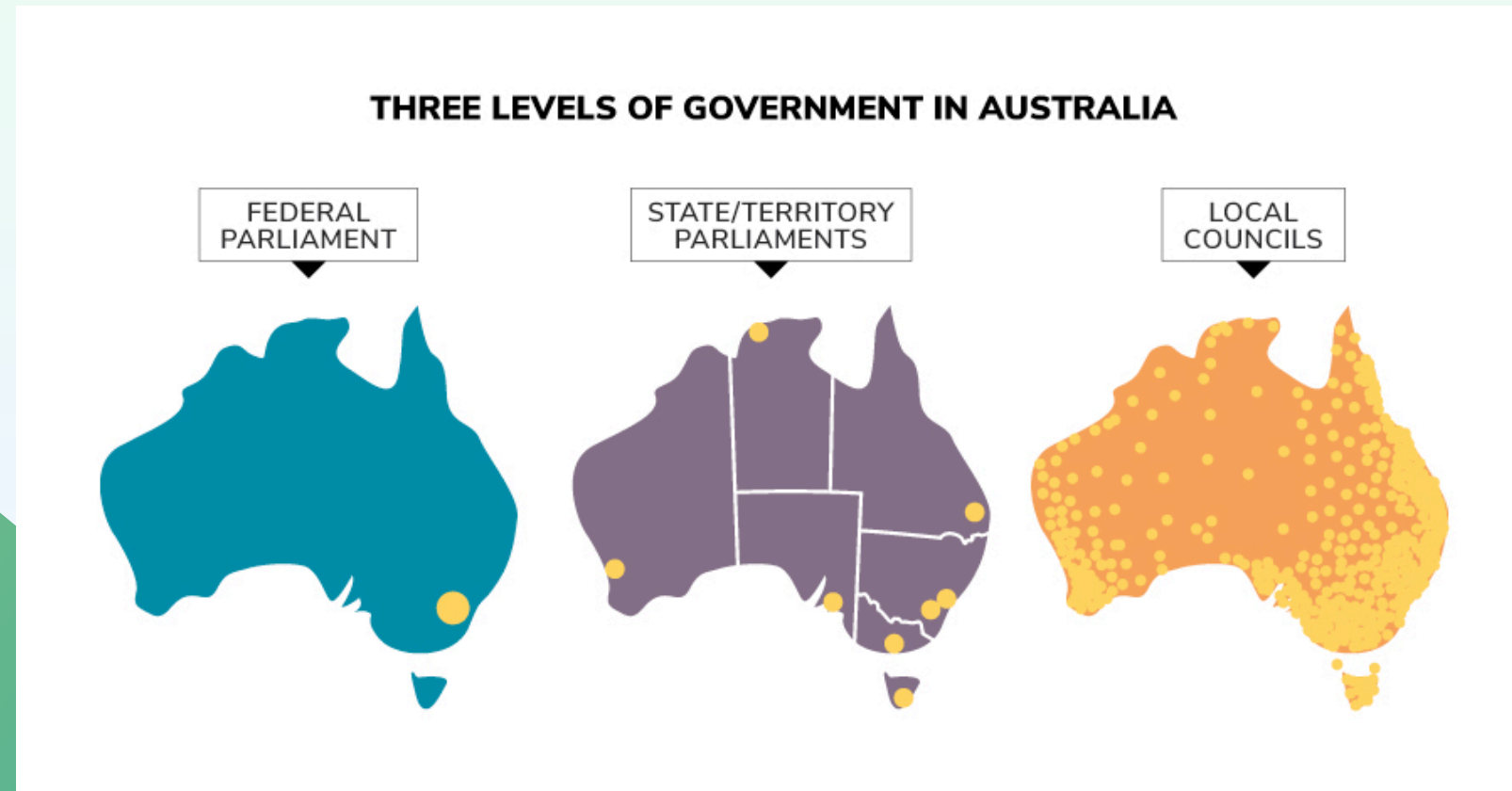
Localised generation and batteries reduces the need for long-distance electricity transmission, improving overall efficiency and reducing cost.

Removes Tier Bypassing

Tier bypassing coordination issues can be addressed by having VPPs controlled by DSOs or operating on distribution markets, instead of AEMO.



How would a DSO be incorporated?



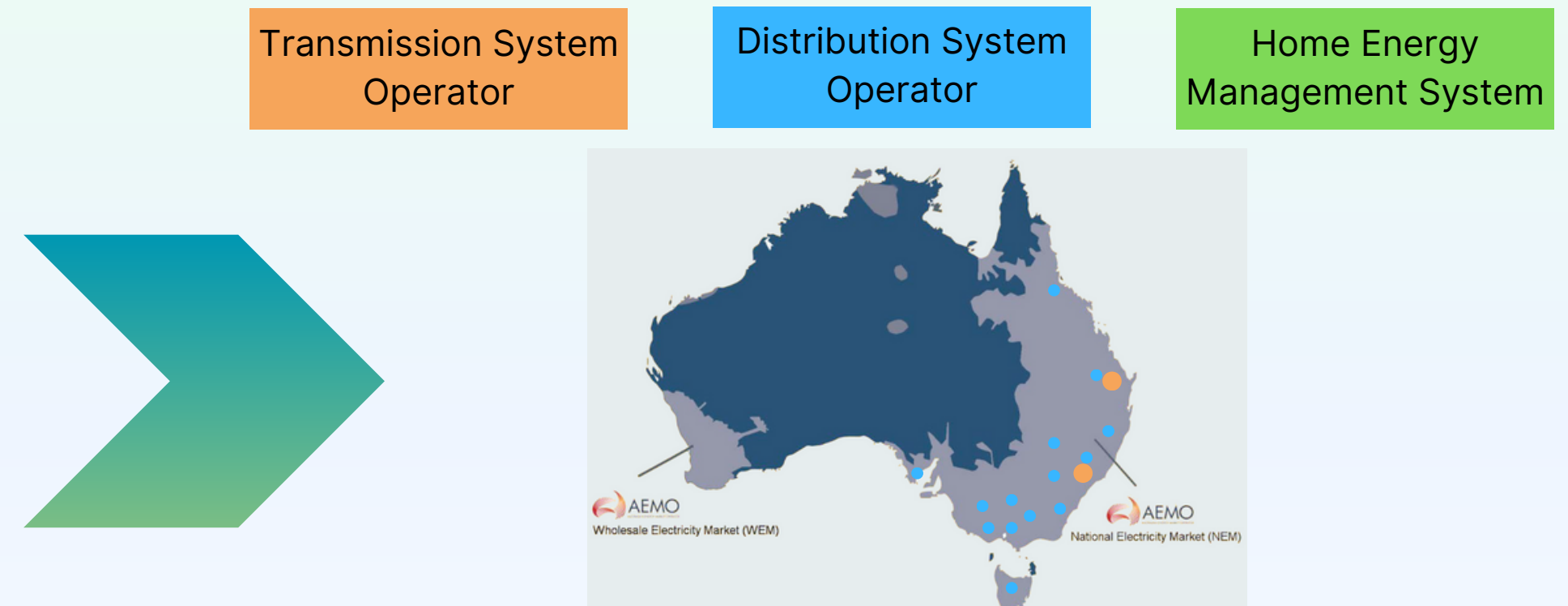
Federal, State and Local governments have different roles and responsibilities.

In the case of emergencies, states have sufficient resources to function independently of the federal government. States can be divided into regions, districts or provinces.

Federal governments coordinate between state governments and provide overarching policies that all state governments adhere to on a national level.

Local governments manage resources on a local level.

Three levels of control in the NEM



Every Transmission Node Identifier (TNI) acts as a minigrid that can function independently or connected to the grid.

Every remote community acts as a microgrid that can function independently or connected to the grid.

Each DNSP becomes a DSO, responsible for:

- Balancing supply and demand within each microgrid and minigrid.
- Ensuring sufficient system security within each microgrid and minigrid should they become islanded.
- Aggregating actual and forecast generation for each TNI.
- Facilitating distribution level markets for rooftop solar, VPPs, battery operators and EVs, flexible demand, located on distribution networks.
- Planning for distribution reliability and security and advising the market of investment opportunities.

AEMO continues to act as the Transmission System Operator and balances the aggregate supply and demand between TNIs.

Home Energy Management Systems (HEMS) allow homes with batteries and EVs to continue to operate if disconnected from the grid due to faults or storm damage.



Key Challenges



Economic Considerations

Funding arrangements need to be determined to uplift DNSPs to become DSOs, and pay for infrastructure upgrades such as advanced controllers, community batteries, synchronous condensers and grid forming inverters.



Cybersecurity Risks

Increased reliance on digital systems makes decentralised grids more vulnerable to cyberattacks, requiring additional funding to harden networks against cyberattacks.



Market and Regulatory Frameworks

Existing rules and regulations are designed for a centralised model and would need major reforms to define DSO responsibilities and incentives.



Interoperability Challenges

Ensuring that different technologies and manufacturers (batteries, inverters, controllers) work together seamlessly is complex and needs regulatory support.

Our energy system is undergoing a transition

We need DSOs to coordinate the rising levels of DER.

And DNSPs are best placed to evolve into DSOs.

It's time to move from theory to implementation.

Let's start the conversation.



About Me

David Lee worked in the Department of Defence for 11 years as a systems engineering manager, leading major projects that relied on layered, hierarchical control systems to coordinate across complex networks – similar to what the energy sector now needs as it transitions toward decentralisation.

After several career breaks to explore the natural world, David became deeply concerned about climate change and completed a Master of Sustainable Energy at the University of Queensland in 2024.

Since then, he has worked on future system design through Energy Catalyst, where he delivered a Concept of Operations for high-DER futures and as a grid connection engineer at the Australian Energy Market Operator (AEMO).

By combining engineering rigour, lived energy system experience, and systems thinking, David now focuses on identifying the structural and regulatory changes needed to unlock a resilient, distributed energy future.



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