



Impact of RE Integration on Market Design: Three Misalignments

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Impact of RE integration

1 Physical Infrastructure
What will the grid look like in a high-RE future?

2 Institutions
What are common challenges for different institutions facing RE integration?

3 Market Misalignments
How is current market design disrupted by increasing RE penetration?

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Physical Infrastructure: New System Needs and Service Providers Emerge

	Low RE Integration	High RE Integration
Supply	<ul style="list-style-type: none"> ▪ Dispatch of generation to meet demand 	<ul style="list-style-type: none"> ▪ Uncertain and variable RE supply
Network	<ul style="list-style-type: none"> ▪ One directional flow 	<ul style="list-style-type: none"> ▪ Bi-directional flow
Demand	<ul style="list-style-type: none"> ▪ Passive demand 	<ul style="list-style-type: none"> ▪ Increased demand-side control

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Institutions: Challenged to Integrate New System Needs and Service Providers

Vertically Integrated Utilities

Market Mechanism

Centralised



Decentralised

VIUS are responsible for all supply-side investment and operational decisions

Markets are used to coordinate decisions within and between supply chain segment

RE integration reveals new system needs and introduce new demand-side stakeholders and increases coordination needs in both contexts

Integration of new system needs and new stakeholders in centralised planning and dispatch practices

Integration of new system needs and new entrants into many-to-many markets that already exist

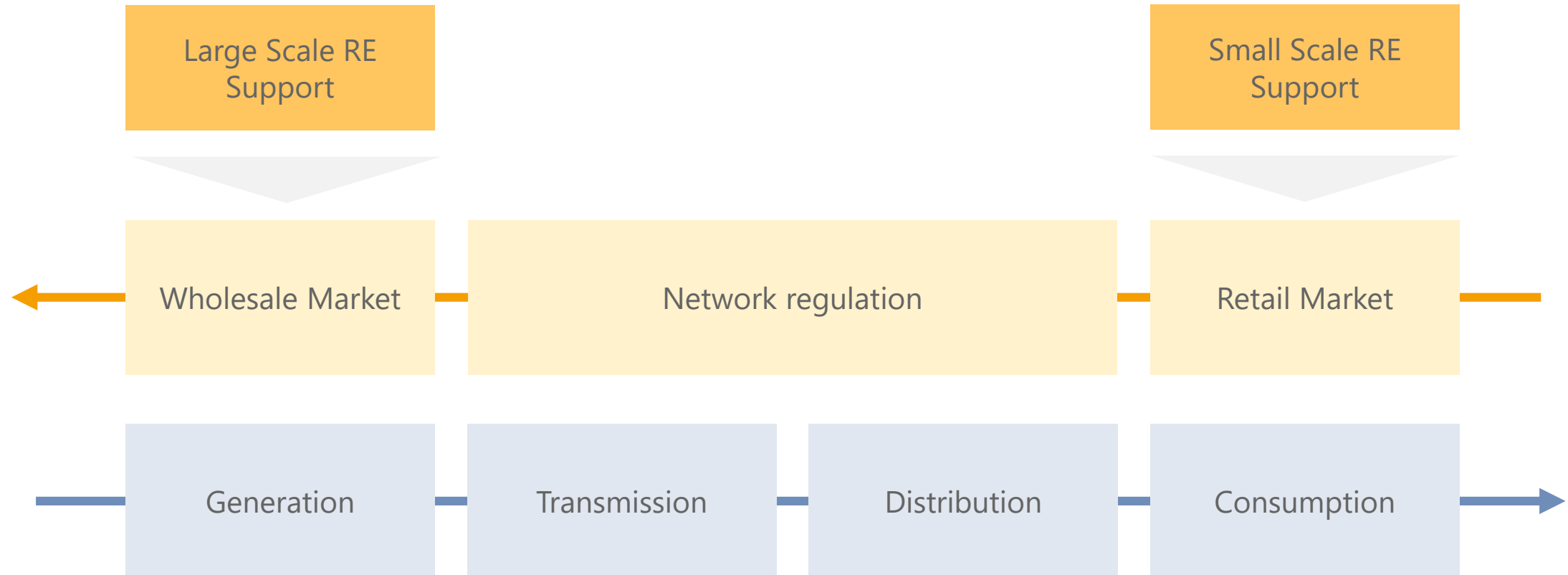
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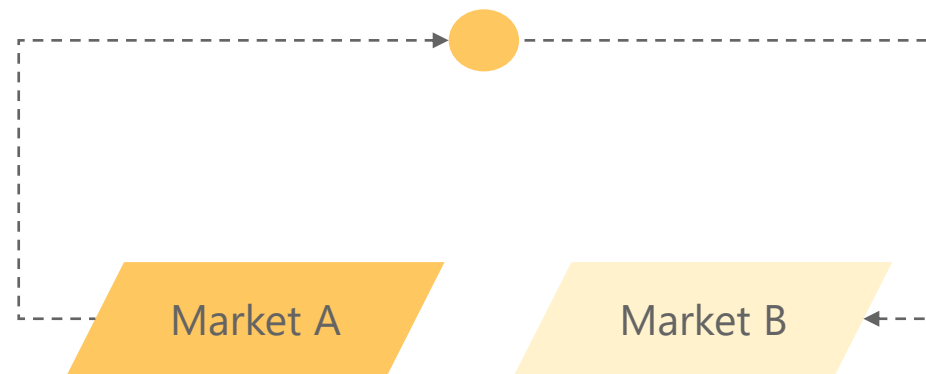
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Market Mechanisms: RE Integration Juxtaposed with Existing Markets



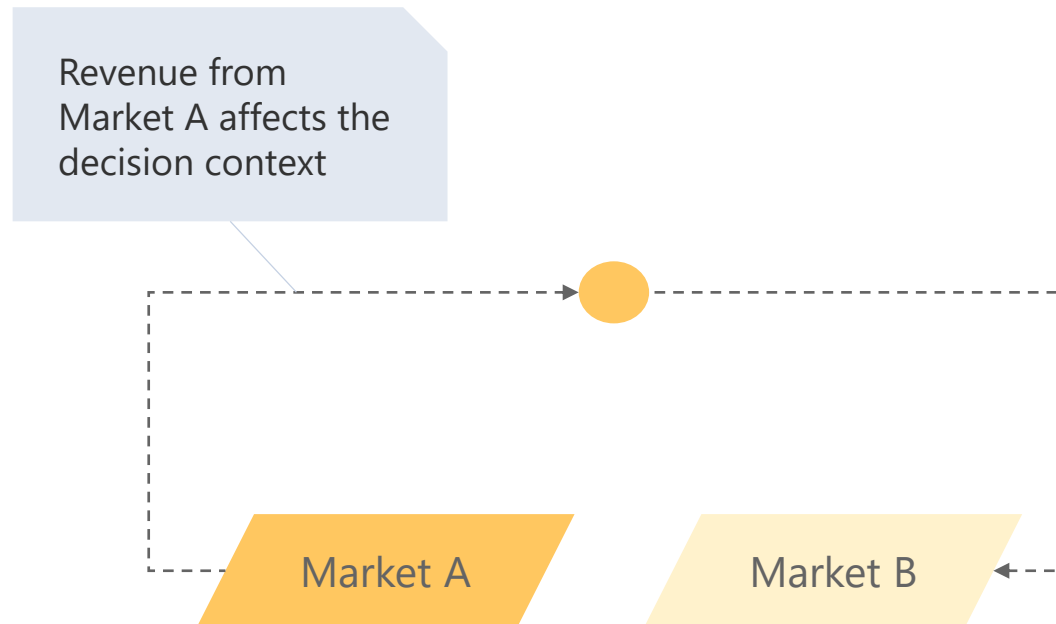
Market Misalignments: Unintentional Inefficient Outcome due to Interaction

Interacting markets are connected by common participants



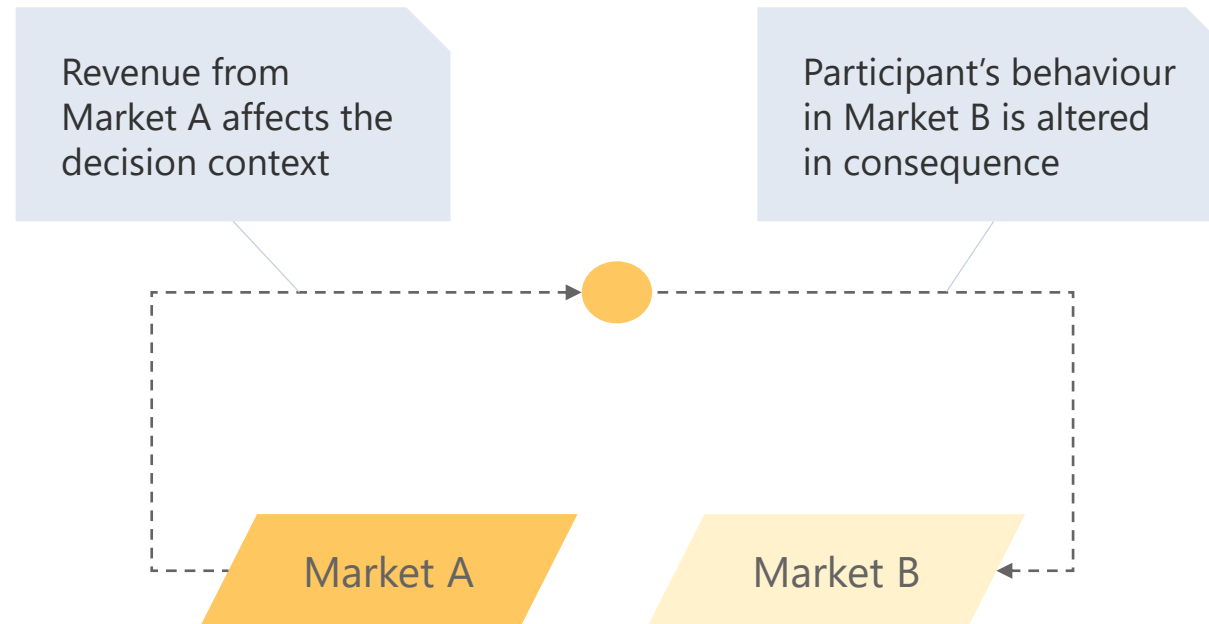
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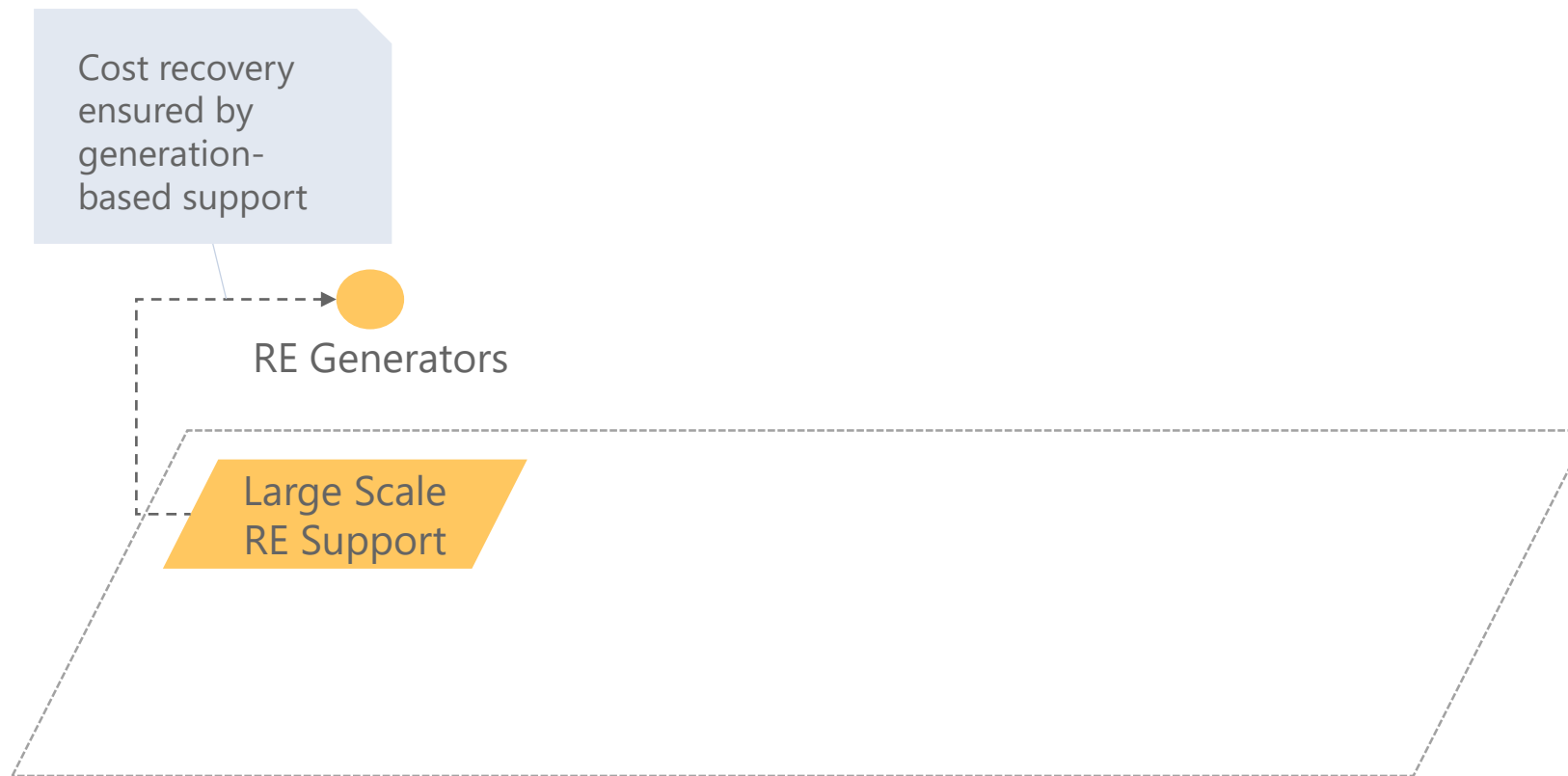
Wholesale Market: Remuneration is Misaligned with New System Needs

Wholesale Market

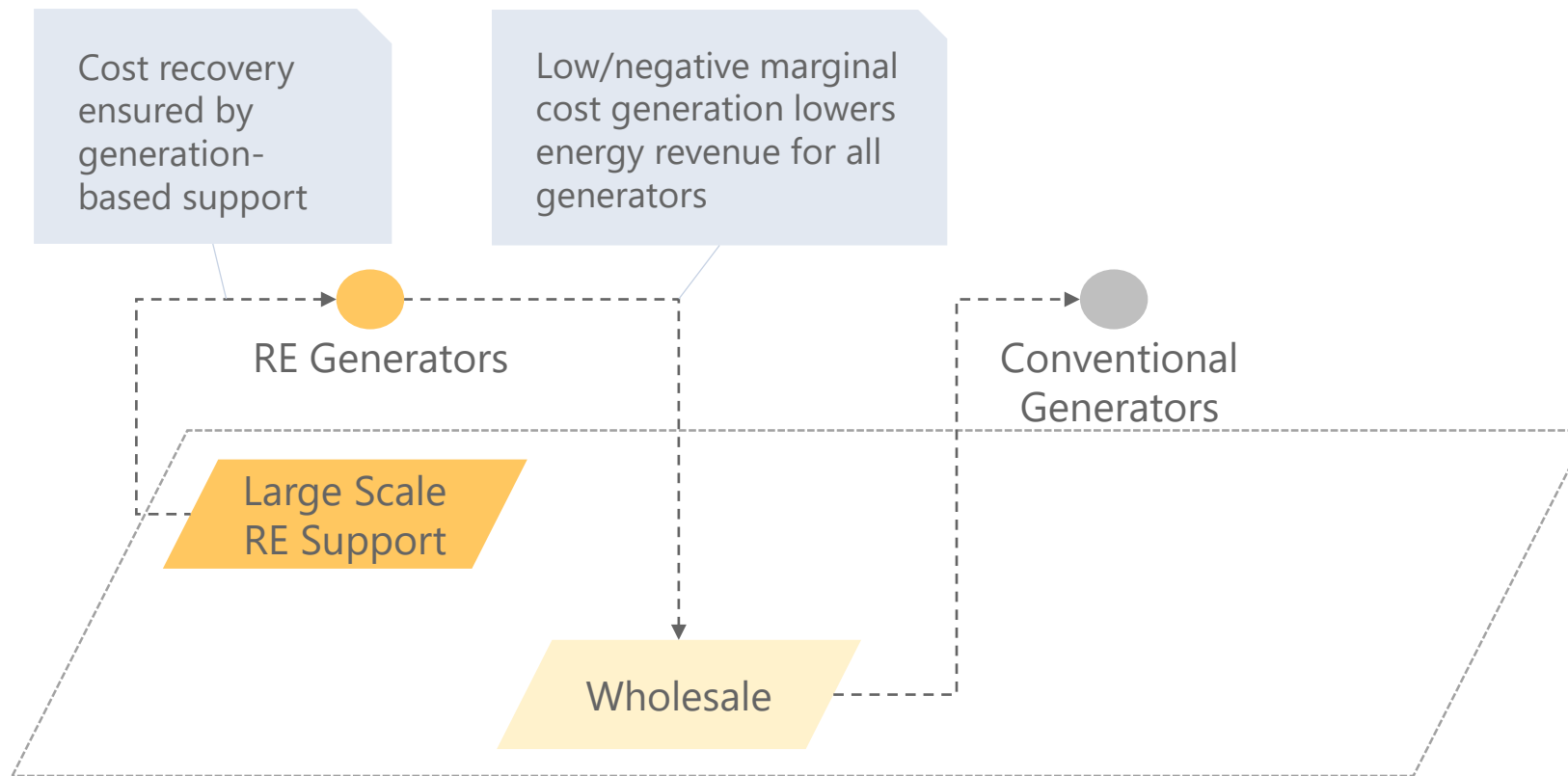
Network regulation

Retail Market

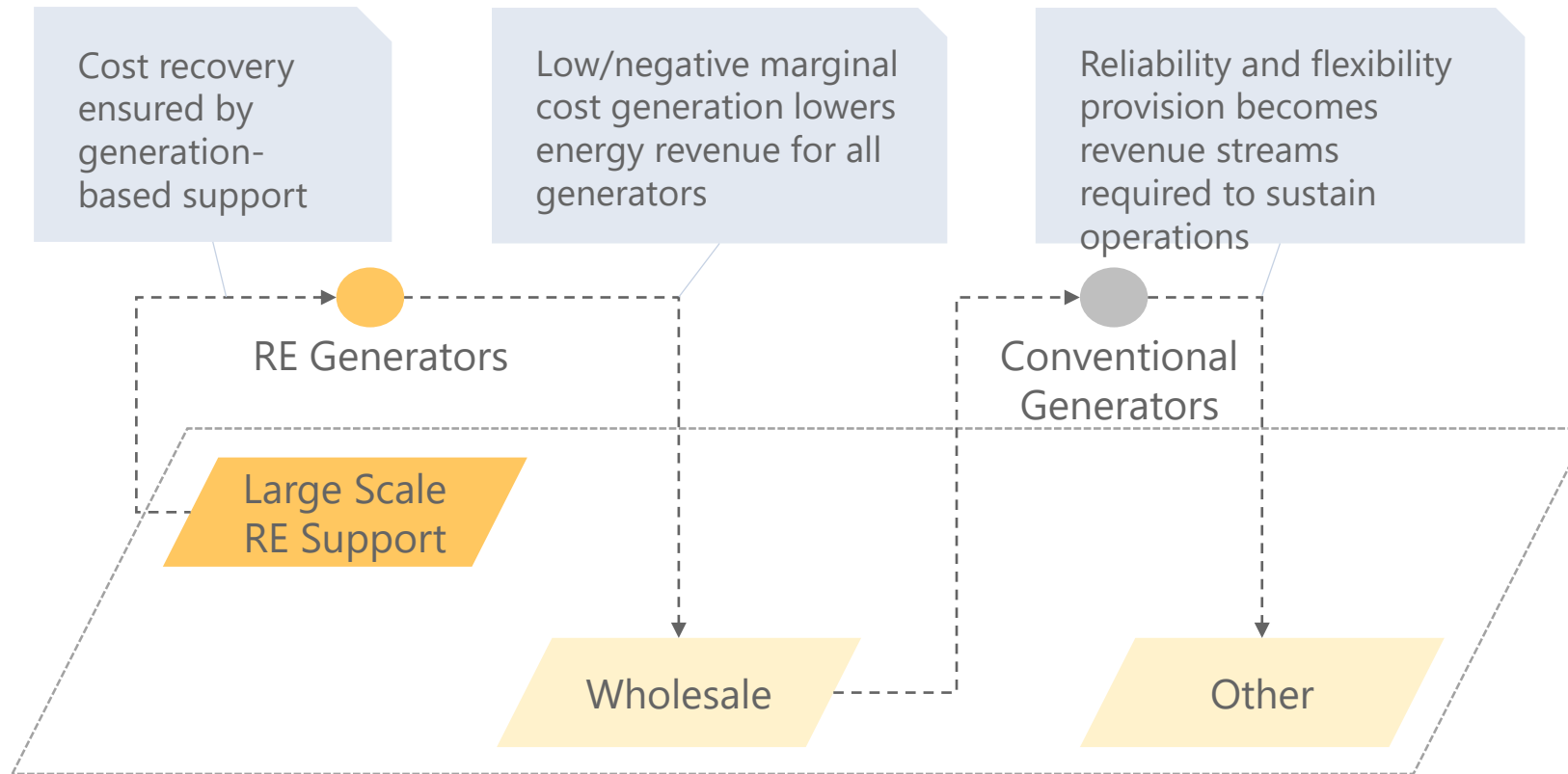
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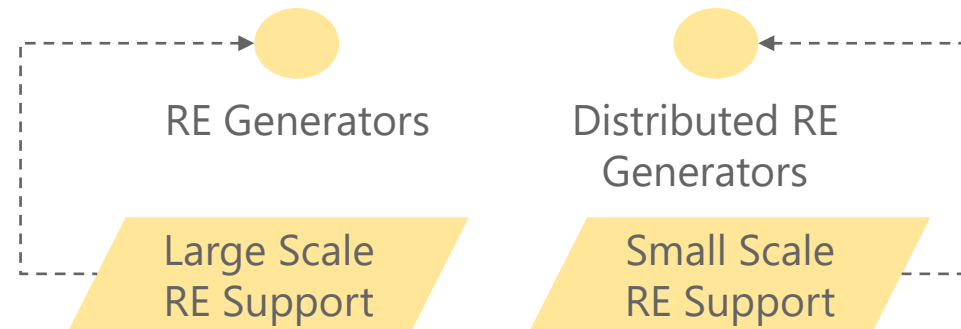
Network Regulation: Generation Investment is Misaligned with Network Capability

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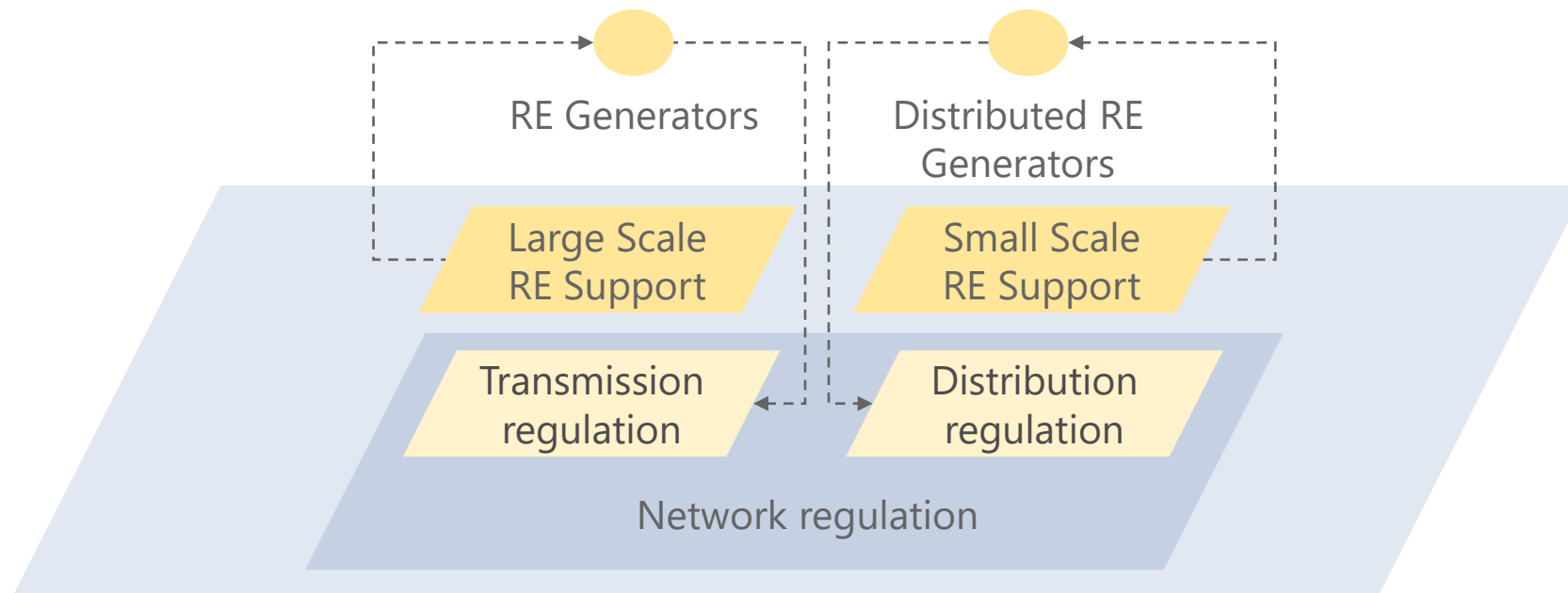
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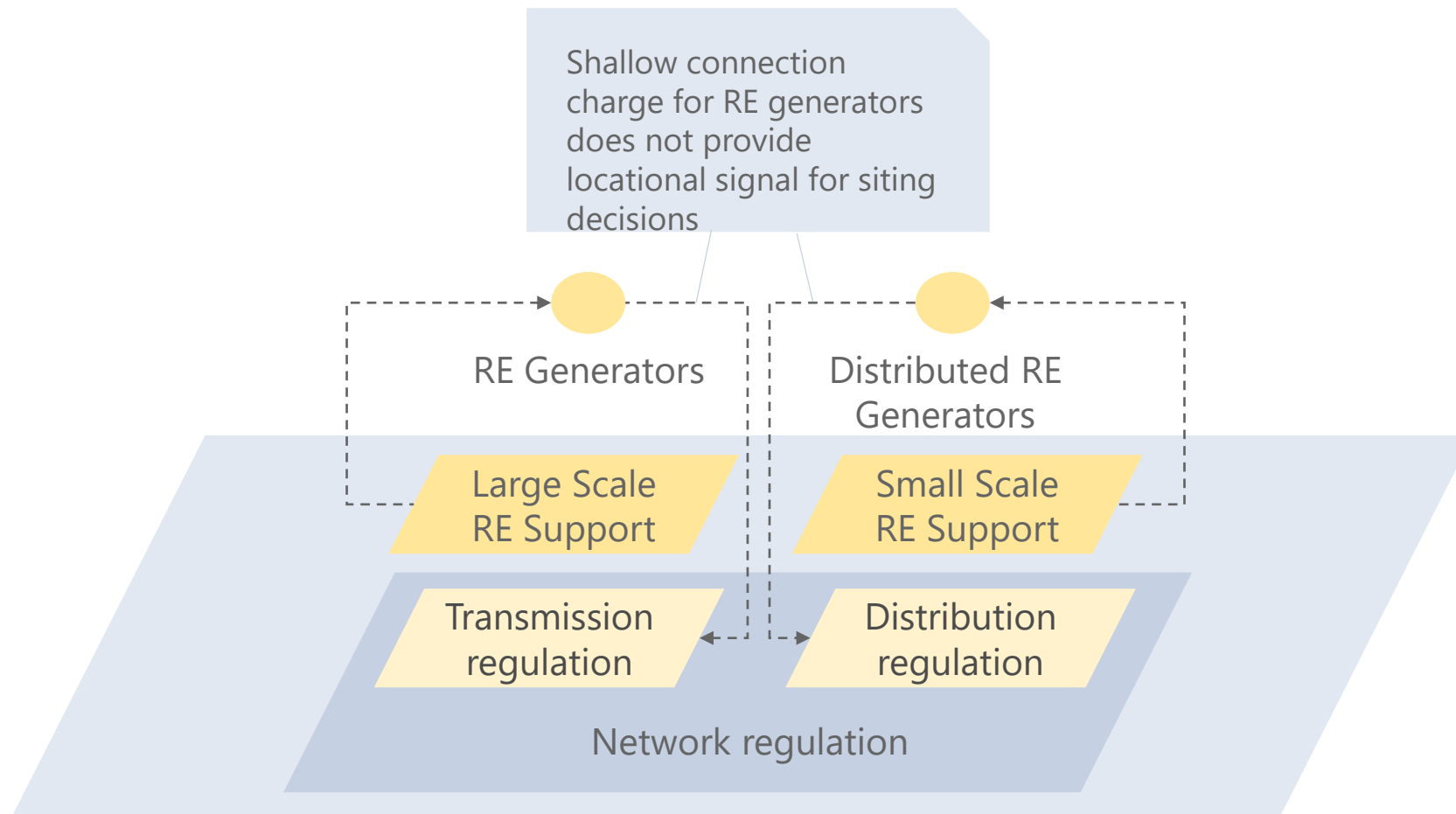
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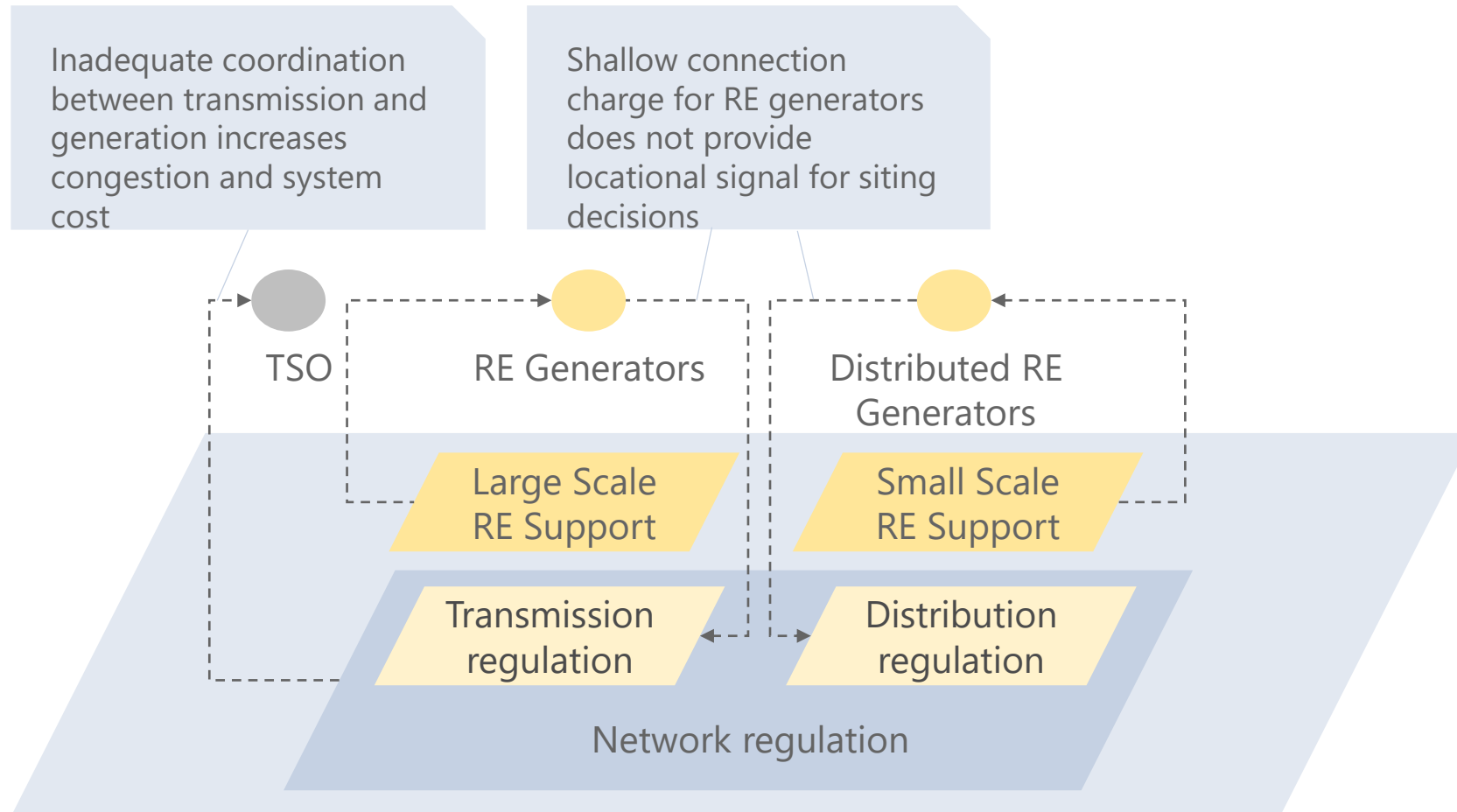
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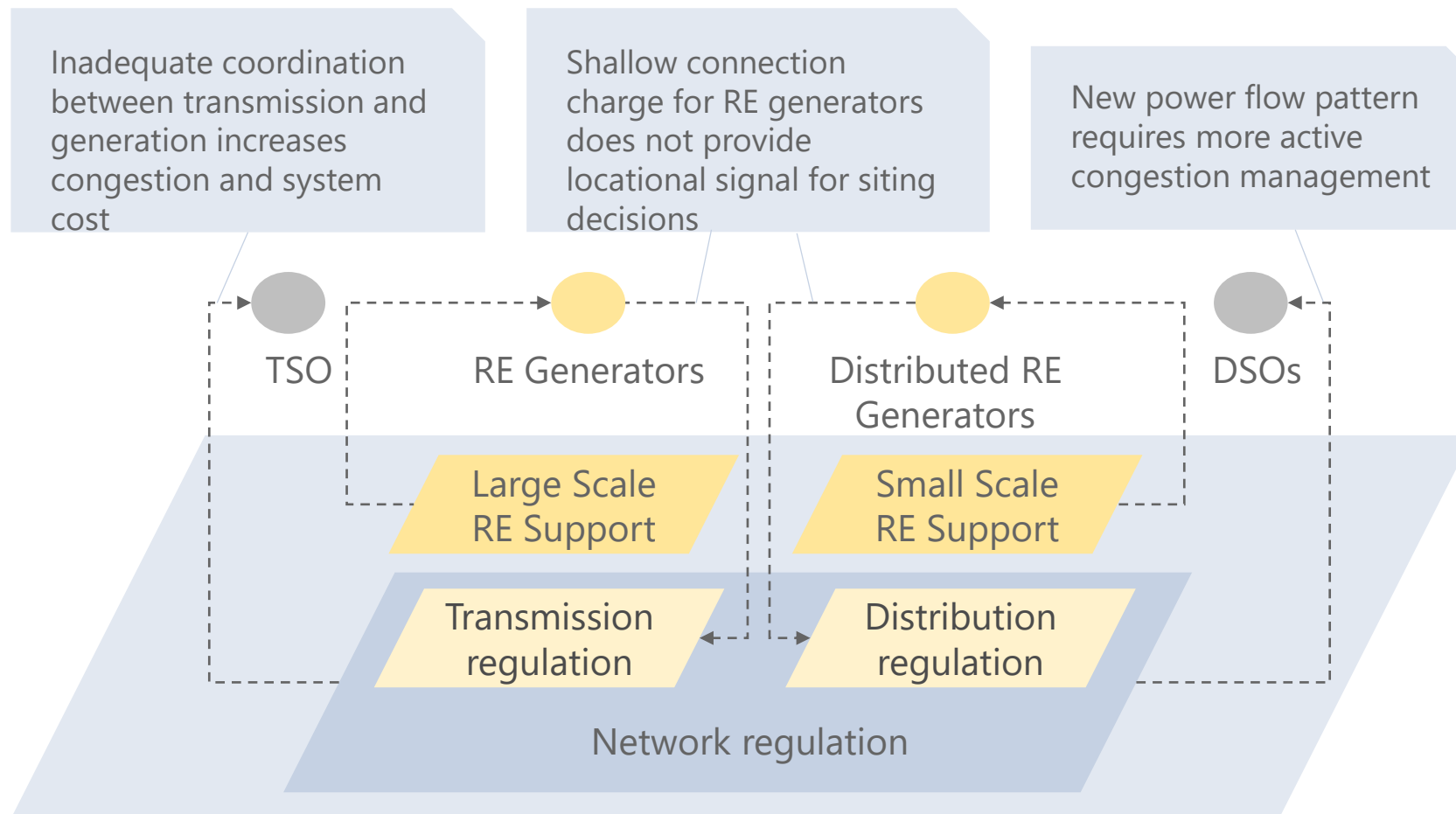
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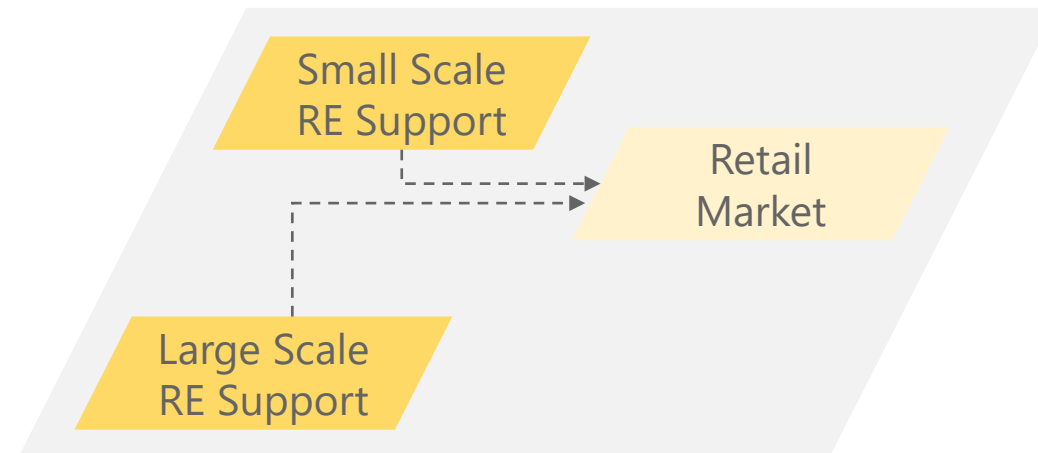
Retail Market: Pricing Structure is Misaligned with Consumer Choices Available

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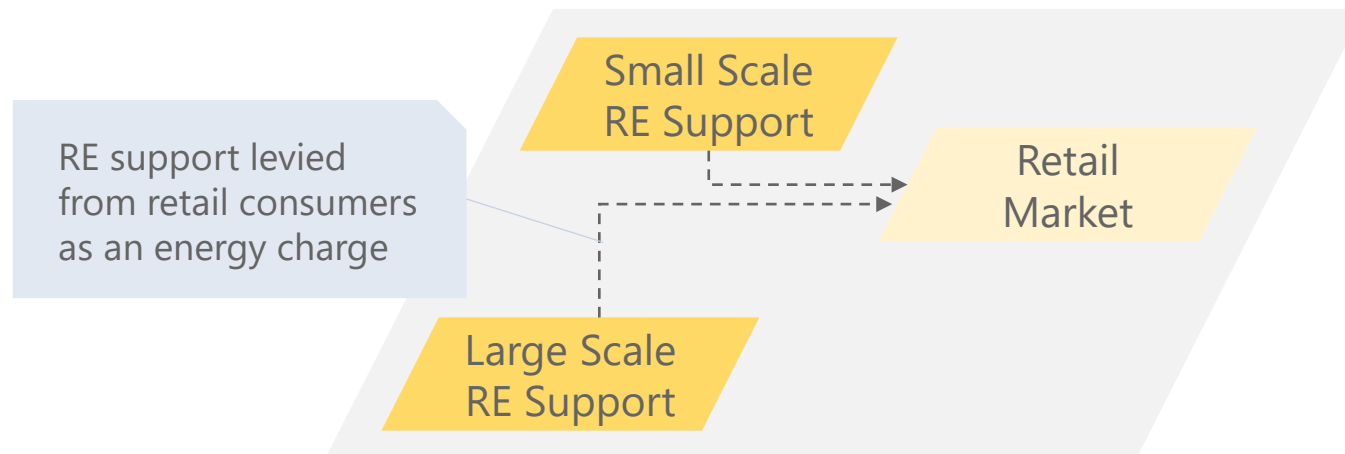
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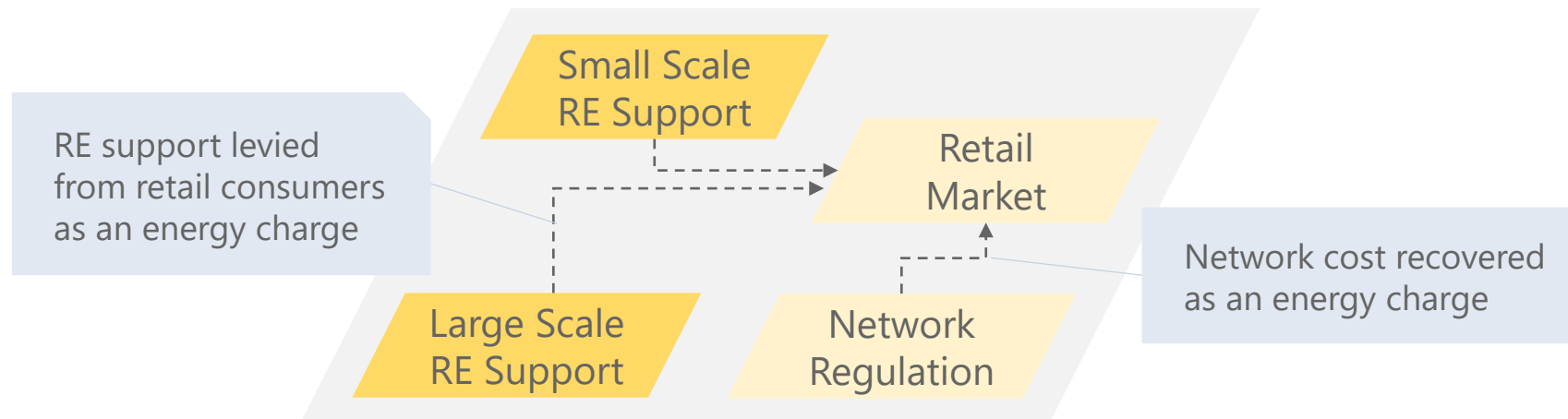
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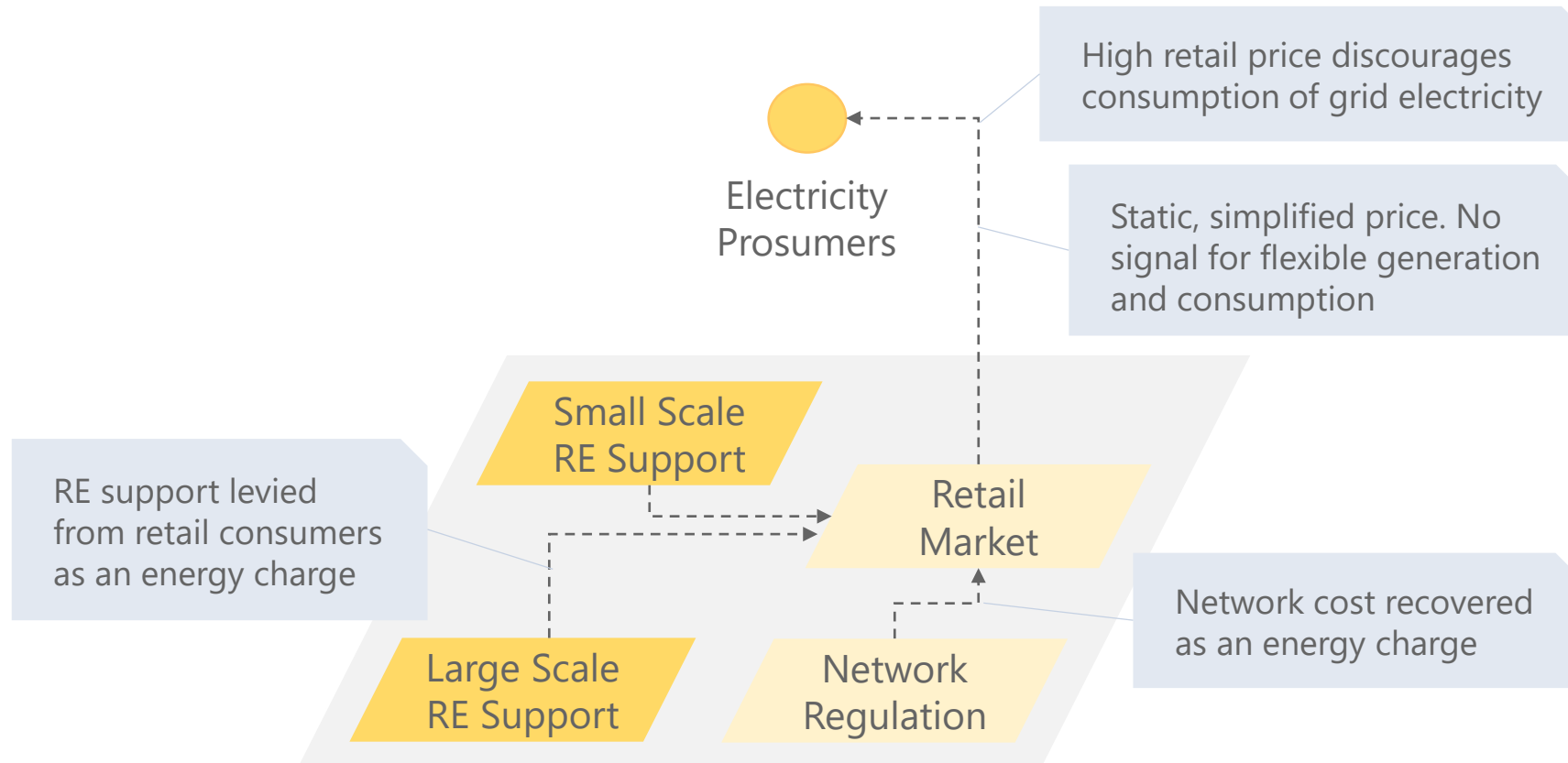
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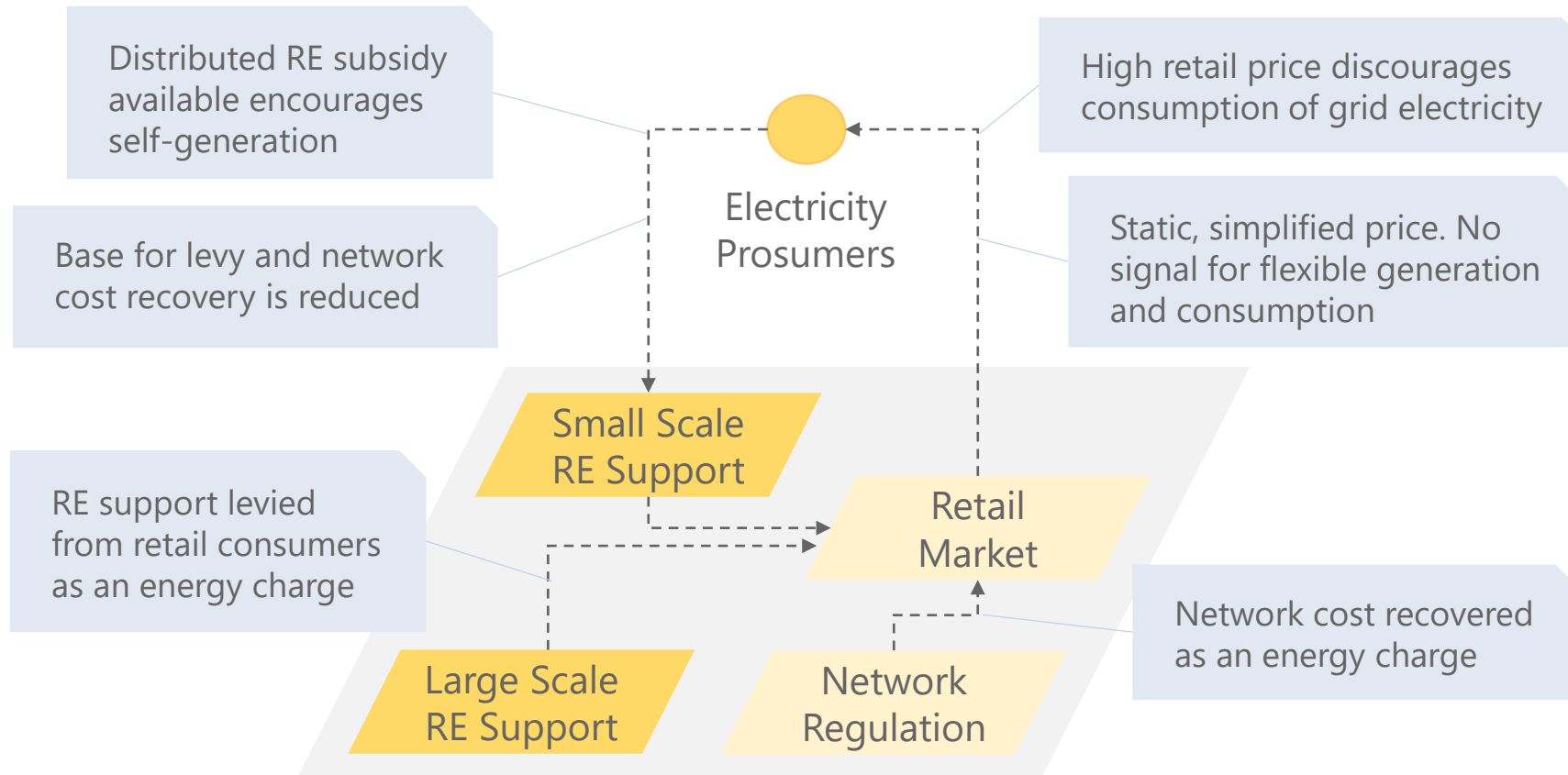
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Impact of RE Integration on Market Design: Three Misalignments

	Wholesale Market	Network Regulation	Retail Market
Misalignment	Remuneration is misaligned with emerging system needs (flexibility, reliability)	Generation investment is misaligned with network capability	Pricing structure is misaligned with consumer choices available
Suggested approaches	<ul style="list-style-type: none"> ▪ Introduction of and improved access to <ul style="list-style-type: none"> – Ancillary services markets – Balancing market – Capacity market 	<ul style="list-style-type: none"> ▪ Spatially differentiated <ul style="list-style-type: none"> – Connection fee – Network access tariff – Energy price ▪ Specification of Renewable Energy Zones 	<ul style="list-style-type: none"> ▪ Capacity-based pricing ▪ Reliability-level based pricing ▪ Access to wholesale market via smart hardware and/or aggregator