The IRENA Electricity Storage Valuation Framework:

Assessing system value and ensuring project viability

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Keeping the power on: Sparking energy storage solutions in developing countries

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The role of electricity storage for VRE integration

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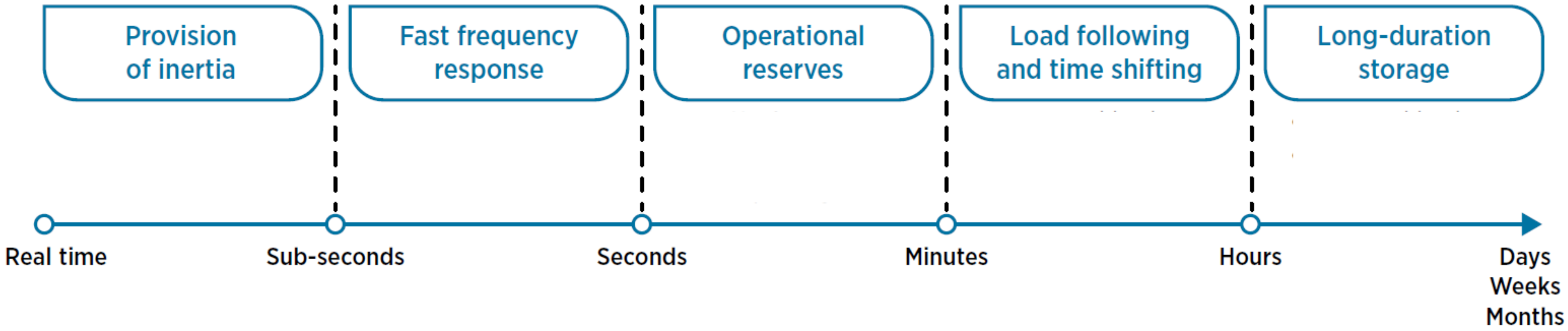
- Solar and wind power are variable and uncertain affecting system operations at various time scales, thus a set of solutions is needed to support system flexibility

- **Electricity storage can support system operations at all time scales**



- **Storage co-located with VRE: Direct benefits to VRE**
  - ✓ Increases firm capacity (participation to capacity markets)
  - ✓ Reduces variability and uncertainty (participation to grid services markets)

- **Stand alone storage: Indirect benefits to VRE by increasing system flexibility**
  - ✓ Reduces operational impacts of VRE
  - ✓ Defers need on other investments (i.e., peak capacity, T&D capacity)
  - ✓ es efficiency and reduces costs of grid services

The objective of the framework – Main guiding questions

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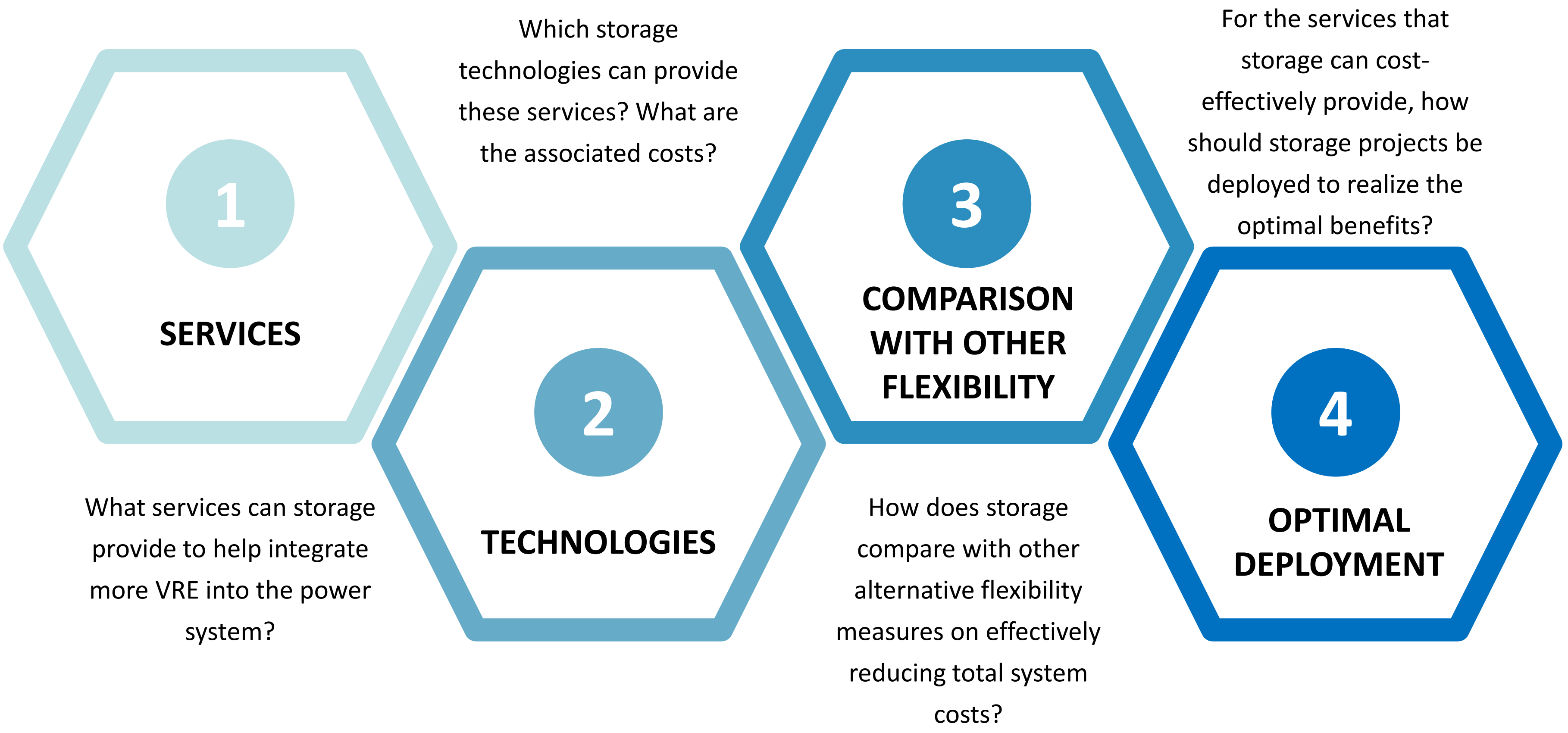

The **Electricity Storage Valuation Framework (ESVF)** aims to guide the development of effective storage deployment frameworks for the integration of variable renewable power generation.

The Electricity Storage Valuation Framework

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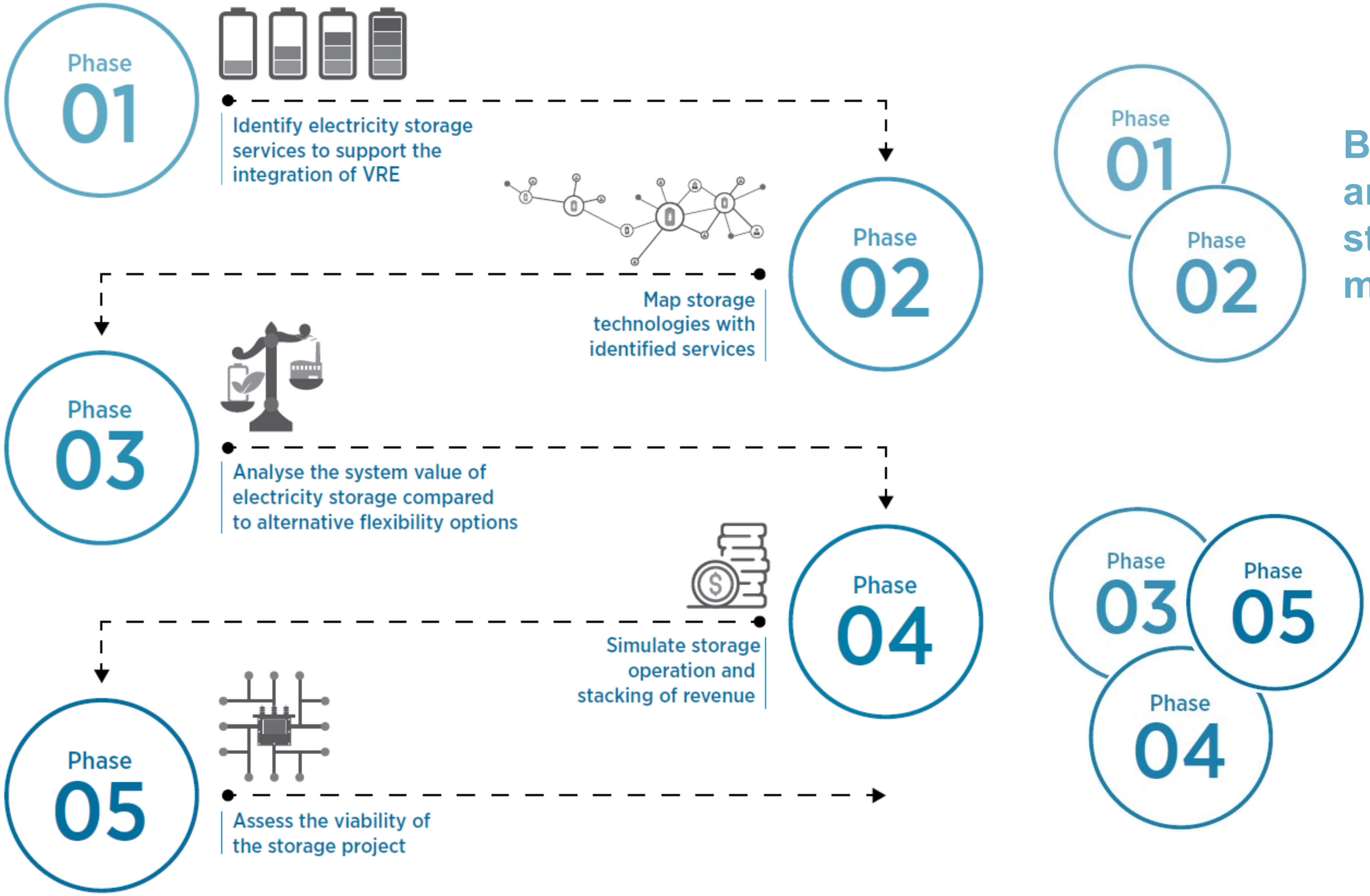

Based on data gathering and application of a straightforward methodology

Based on different types of optimization models to carry out the analysis

Recommendations for different stakeholders

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For electricity storage developers

Get familiar with existing business models and collaborate closer with regulators and utilities to highlight system benefits of ES.

For vertically integrated utilities

Update planning tools to include ES and update procurement processes for services required, rather than picking technologies.

For regulators

Eliminate barriers for ES participation in different markets, create new markets able to capture the value of ES, make incorporation of least cost planning for ES mandatory for TSOs and DSOs. .

For the research community

Support further development of tools and methodologies to perform ES valuation, develop scenarios to study benefits of ES.

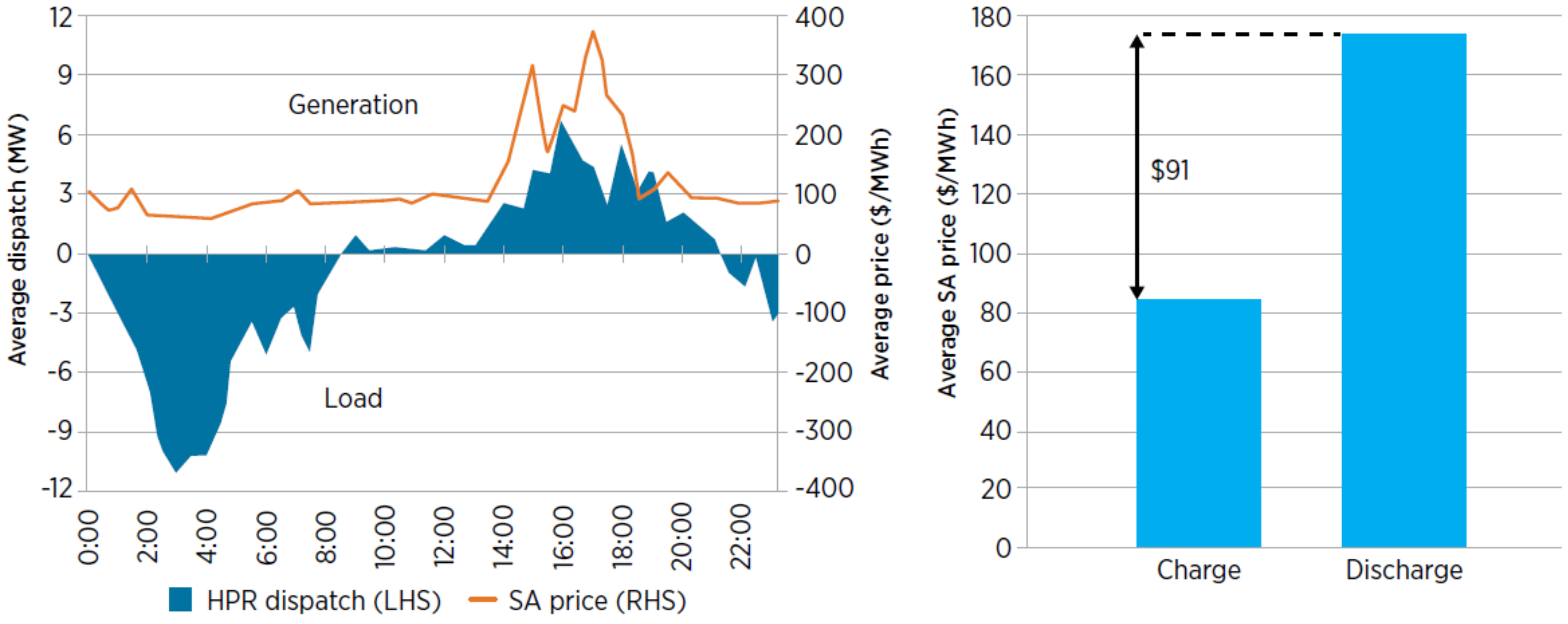
Case 3: Energy Arbitrage

1. The Role of Energy Arbitrage for VRE Integration

- Comprises of storing electricity at times when energy is plentiful and inexpensive and discharging it to the grid when it is scarce and most expensive
- It can be performed between day ahead and real time markets
- Storage operators should be able to predict/anticipate when and in which direction large forecast errors will occur

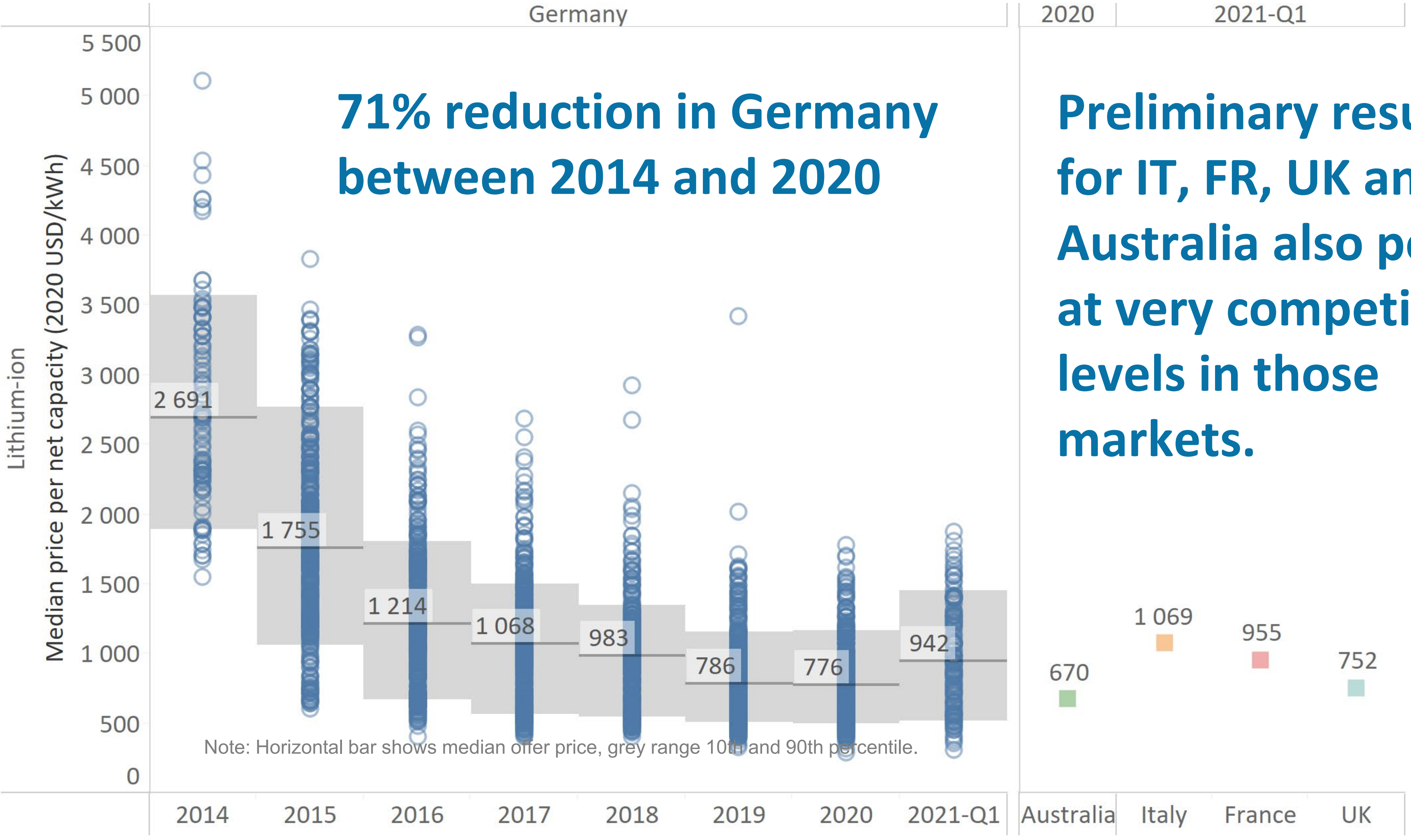
2. Real-life Scenario

- **Hornsdale Power Reserve** in South Australia, largest lithium-ion battery at time of its deployment in 2017 – 129MWh, 100MW discharge, 80MW charge
- Connected to 275kV grid of Hornsdale wind farm (315MW)
- Has been providing energy arbitrage and regulation and contingency frequency control ancillary services (FCAS) – energy arbitrage alone is often insufficient
- Figure shows how arbitrage is successfully making money



HPR Average Dispatch and Charge & Discharge Price

Small-scale: increasingly competitive markets



Source: IRENA based on EuPD Research Australian data based on Solar Choice.

Conclusions

- ES supports VRE integration and its large-scale deployment can provide considerable benefits to the power system and the society in general (i.e. economic, technical, environmental)

- ES deployment will only happen if the “missing money” gap between project-level monetizable and system-wide non-monetizable benefits of ES will be bridged

- Bridging the “missing money” requires **regulatory restructuring and policy support**, to be based on the results of techno-economic analysis to assess costs and benefits of ES

- Cost-benefit analysis of ES need to consider the following:
  - Technical suitability of ES for specific system services – focus on those required for VRE integration
  - Techno-economic comparison of ES against alternative options
  - Estimation of both monetizable and non-monetizable benefits of ES and comparison with ES costs

- Application and use of the ESVF requires some expertise on analytical tools and comes with a number of constraints:
  - Estimation of ES at the distribution level need to be based on assumptions and simplifications
  - Accuracy of results depends on spatial and temporal granularity of tools used in the analysis

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