POLICY TECHNOLOGY MARKET
ENERGY STORAGE Global Conference
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Valuing Behind-the-Meter Energy Storage

Session: 1

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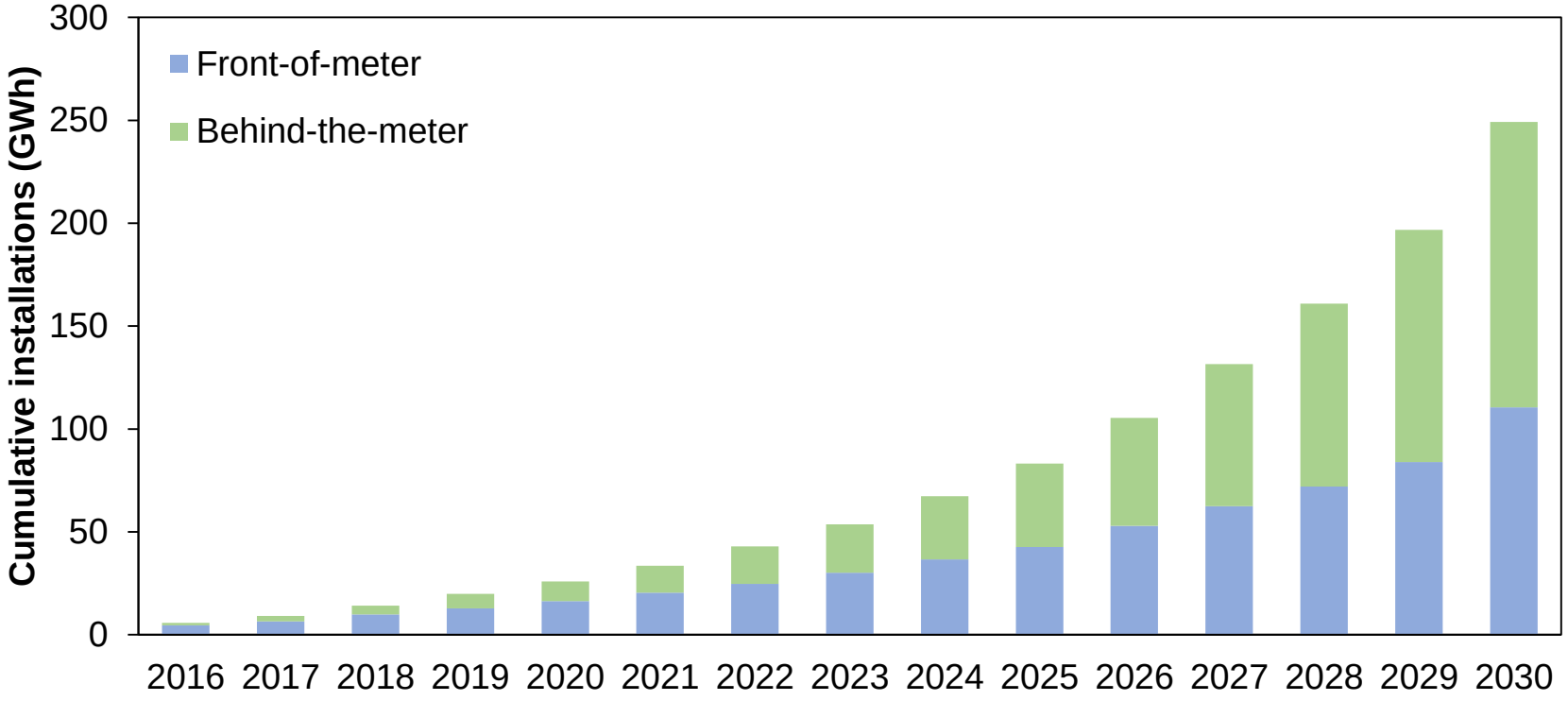
Behind-the-meter storage is projected to dominate the stationary storage market

Market Size (Global)

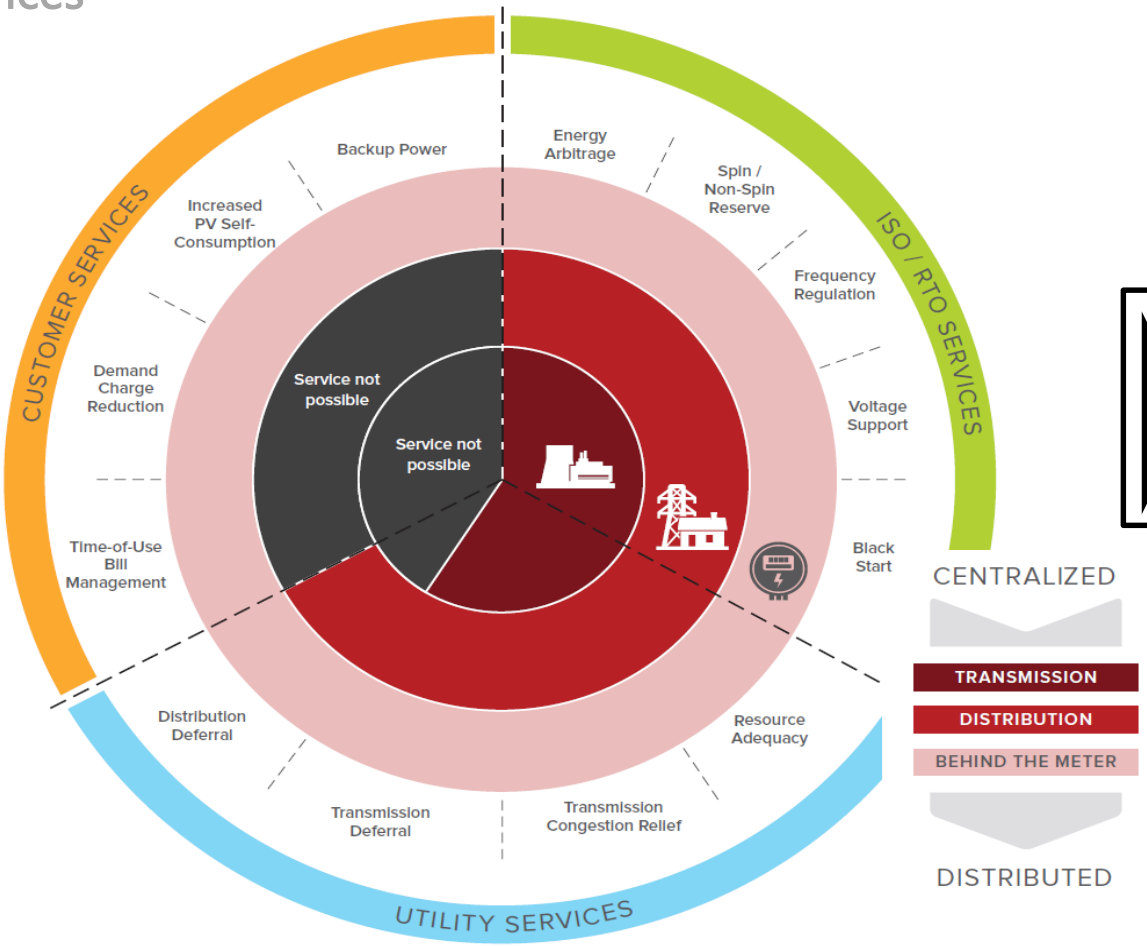


The market for behind-the-meter storage will grow substantially

Source: Sekine, Y., Goldie-Scot, L., 2017. 2017 Global Energy Storage Forecast. Bloomberg New Energy Finance.

This is driven by the range of services behind-the-meter storage could provide

Services

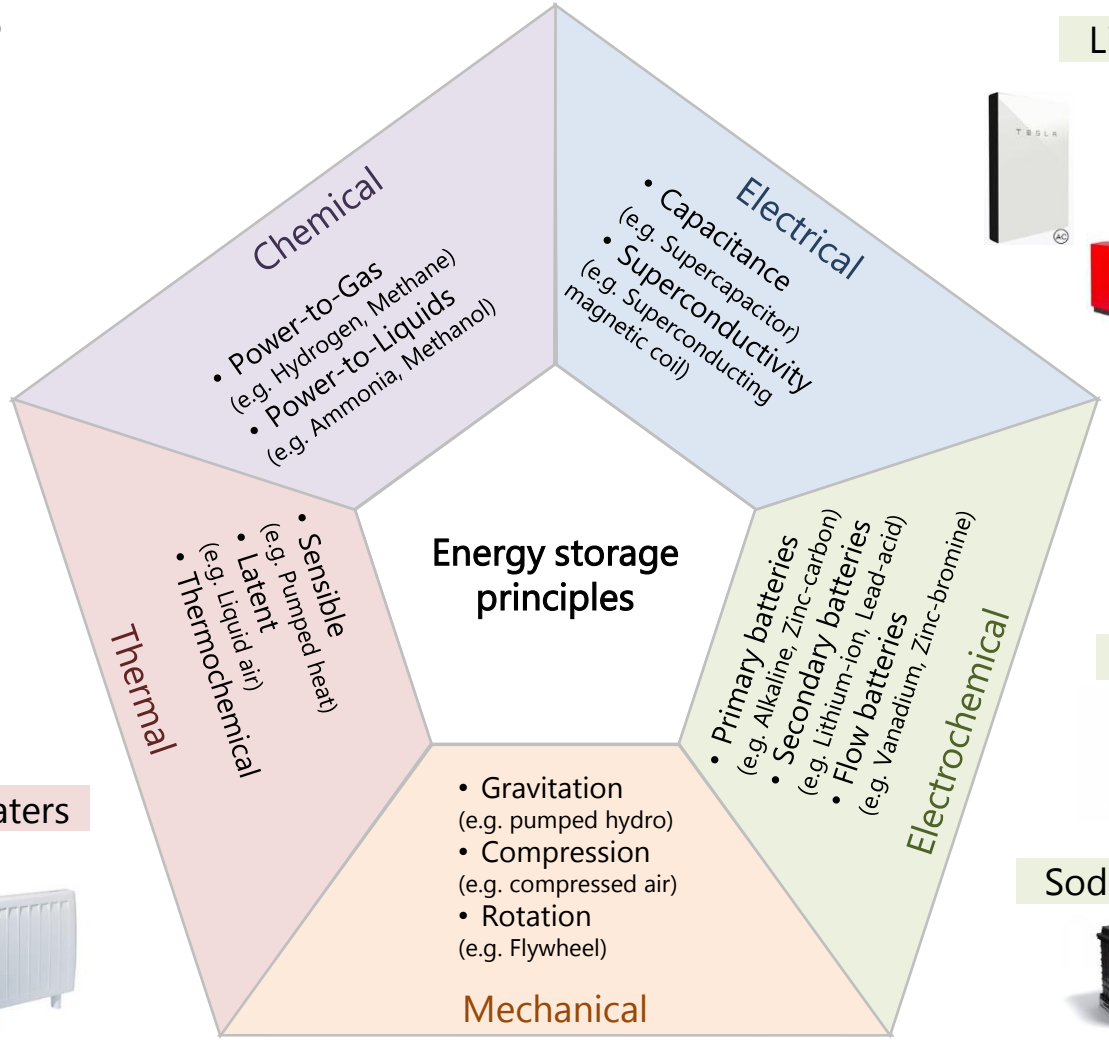


Behind-the-meter storage can provide all customer, utility and network services

Source: Fitzgerald, G., Mandel, J., Morris, J., Touati, H., 2015. The Economics of Battery Energy Storage: how multi-use, customer-sited batteries deliver the most services and value to customers and the grid. Rocky Mountain Institute.

In theory, all energy storage technologies could be installed behind-the-meter

Technologies



Lithium-ion

Lead-acid

Redox-Flow

Sodium-ion

Hot water tank

Storage Heaters

But, residential behind-the-meter electricity storage is not profitable

UK Case Study

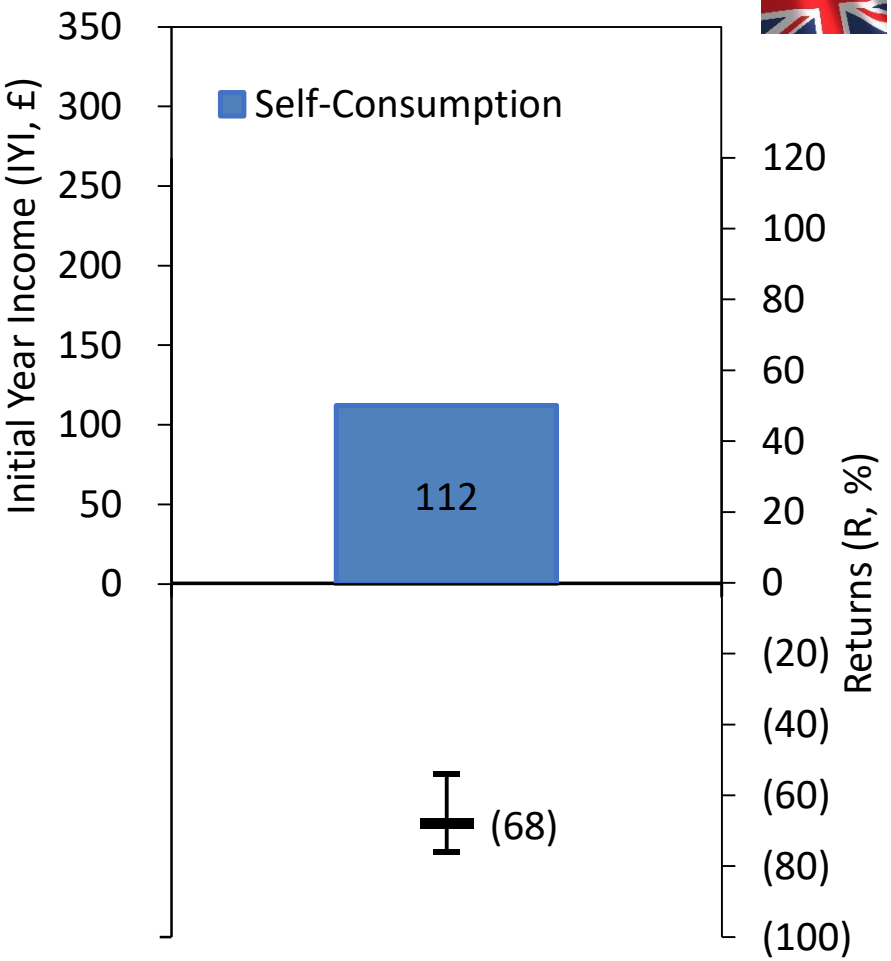
<u>Setting & Use Case</u>

- Residential home with PV system
- PV self-consumption

→ Retrofit battery

<u>Model parameters</u>

- Year: 2020
- Technology: 4 kWh li-ion battery
- Cost: £ 3,400 (all-in)
- Lifetime: 15 years
- Degradation: 1% pa (90% DoD)
- Power price: 14 p/kWh (exp: 4.9p/kWh)
- Discount rate: 5% (0% - 10%)



Source: Gardiner, D. *Quantifying the impact of policy on the investment case for residential electricity storage in the UK.* 2018 [submitted]

We identify 6 policy barriers that prevent a positive residential business case…

Policy barriers

1. Lack of Time-of-Use tariffs
2. Lack of valuation for network services
3. Regulatory barriers for benefit-stacking

Valuation of services provided by residential storage

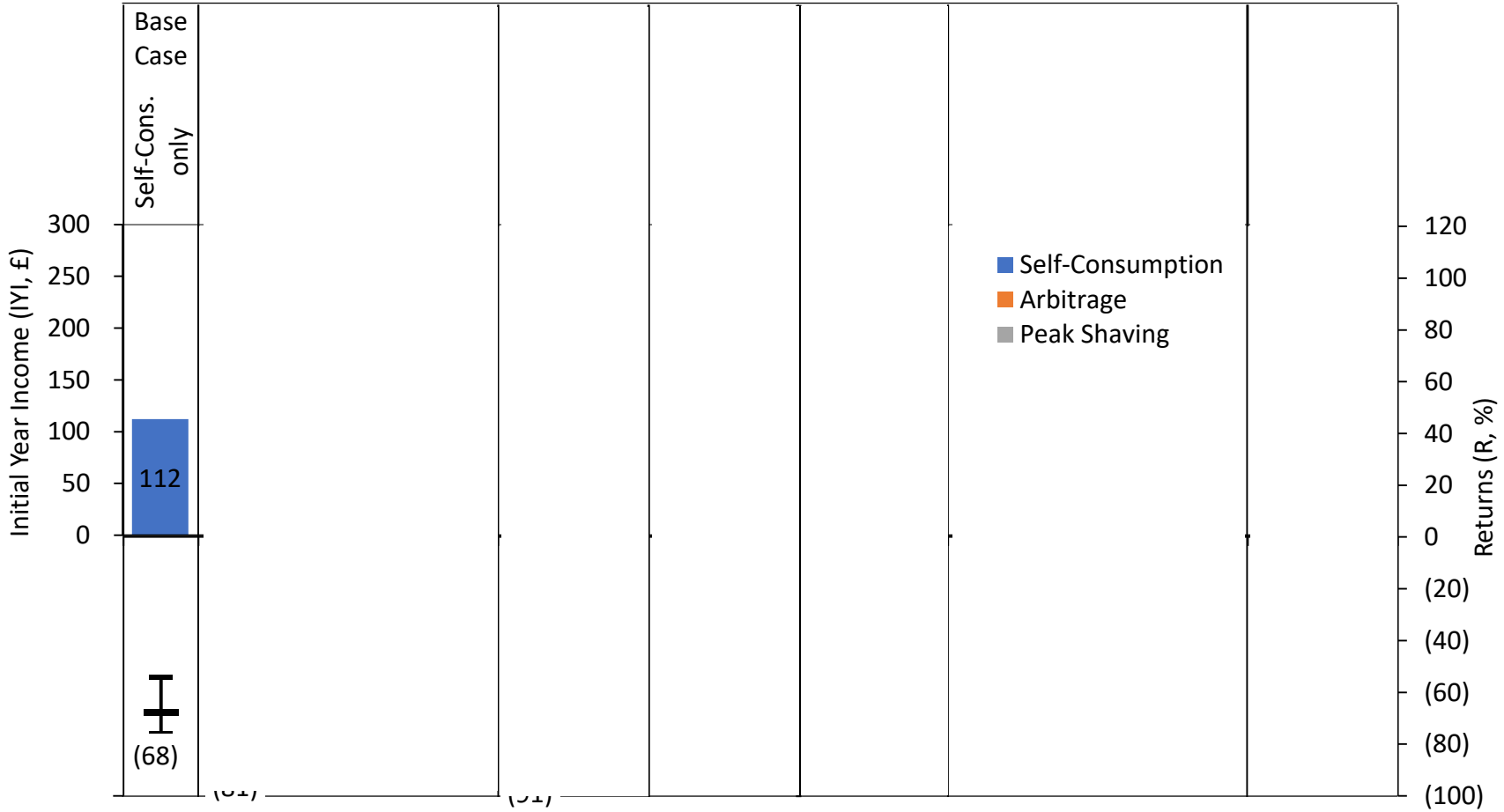
4. High VAT rate for retrofit installations
5. Lack of subsidies
6. High financing cost

Financial support for residential storage

Source: Gardiner, D. *Quantifying the impact of policy on the investment case for residential electricity storage in the UK.* 2018 [submitted]

… and quantify the impact of resolving these barriers with policy measures

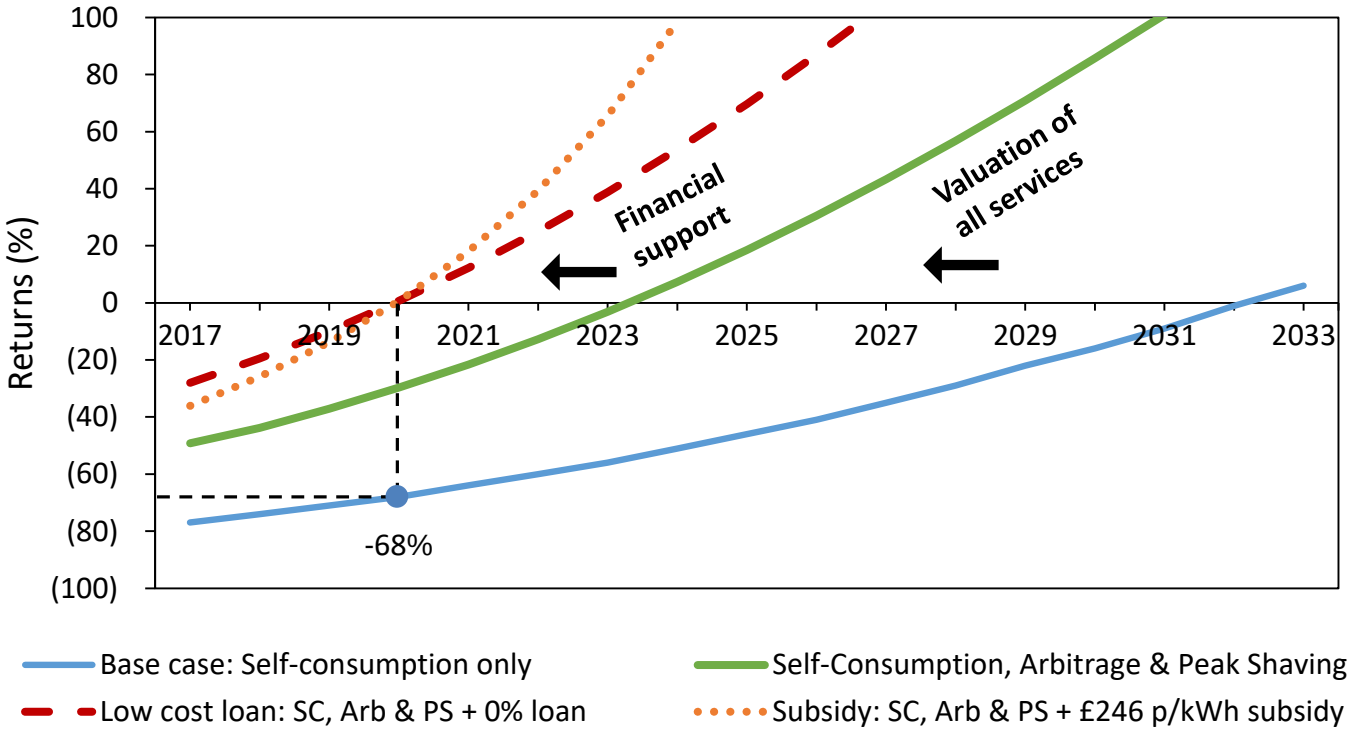
Quantifying policy measures



Source: Gardiner, D. *Quantifying the impact of policy on the investment case for residential electricity storage in the UK.* 2018 [submitted]

A combination of low cost policy measures enables profitable b-t-m storage by 2020

Combining policy measures



▶ Policy action required to ensure valuation of all services

Source: Gardiner, D. *Quantifying the impact of policy on the investment case for residential electricity storage in the UK.* 2018 [submitted]

Behind-the-meter storage requires policy action for full valuation of its services

Conclusions

1. Market for behind-the-meter (b-t-m) storage will grow substantially
2. B-t-m storage can provide all customer, utility and network services
3. Profitable business cases stack multiple value streams
4. Policy action required to ensure valuation of all services

Q&A

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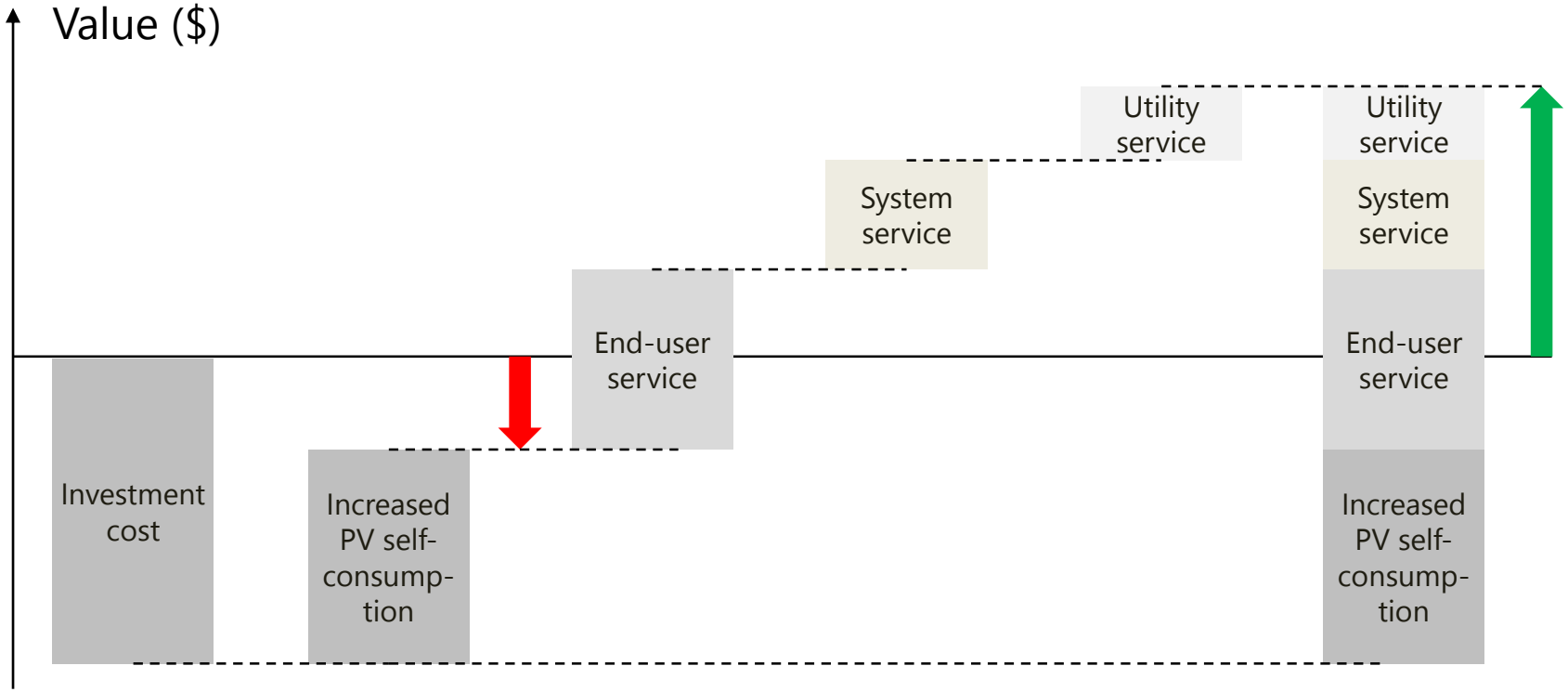
The stacking of multiple revenue streams is seen as the path to profitability

Benefit-stacking

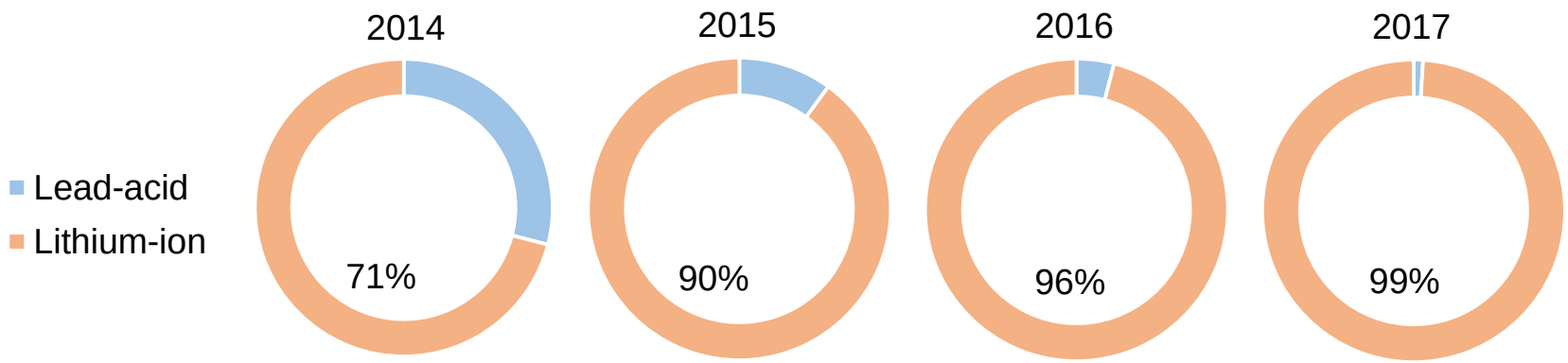


Profitable business cases stack multiple value streams

However, recent years have seen increasing dominance of one battery technology

Technologies – German Residential Market

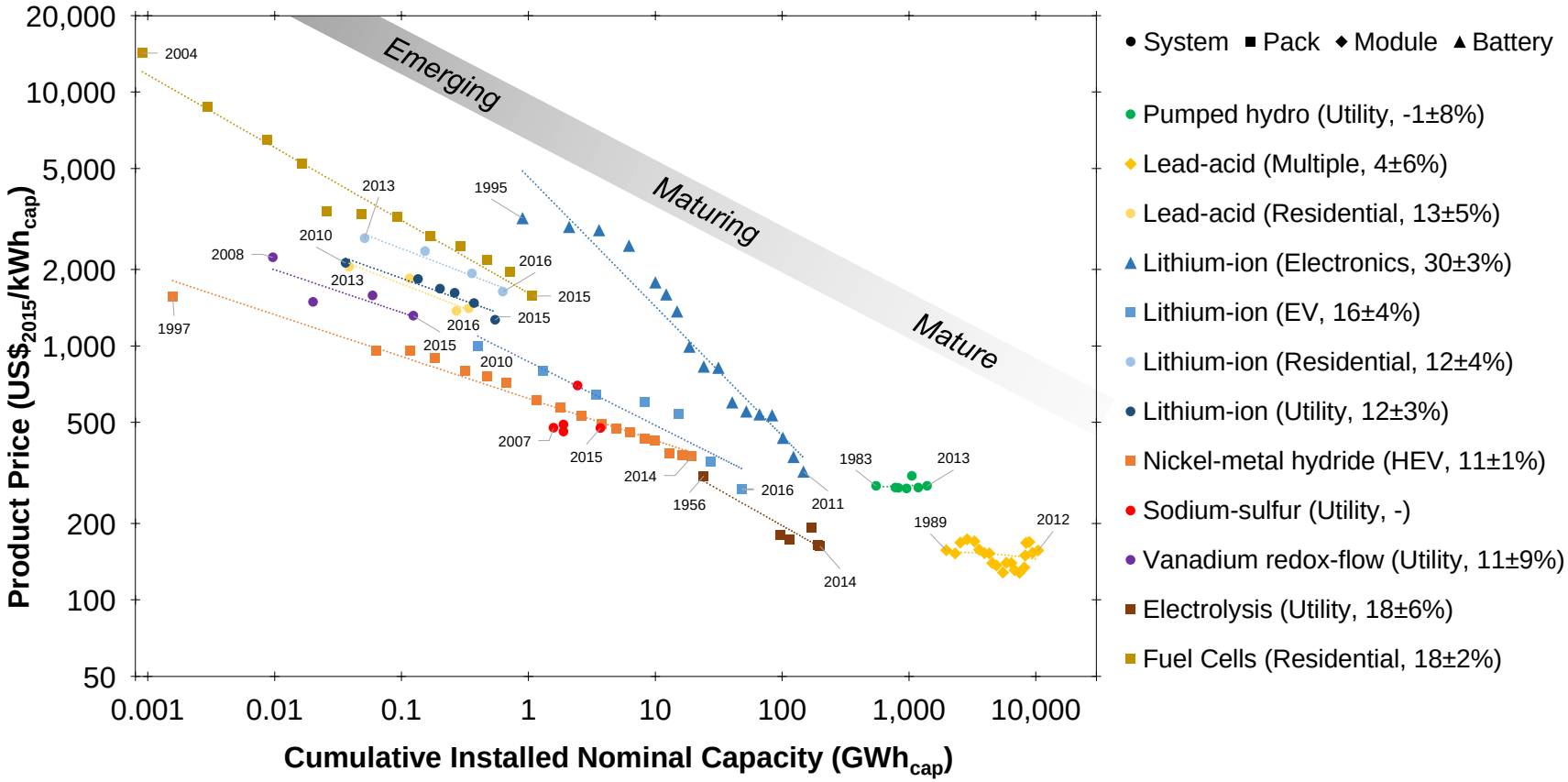
Proportion of lead-acid / lithium-ion systems ≤ 30 kWh installed behind-the-meter:



Source: Tepper, M. Stromspeicher-Preismonitor 2017. Bundesverband Solarwirtschaft e.V. (BSW-Solar)

Experience curve dataset for electricity storage technologies

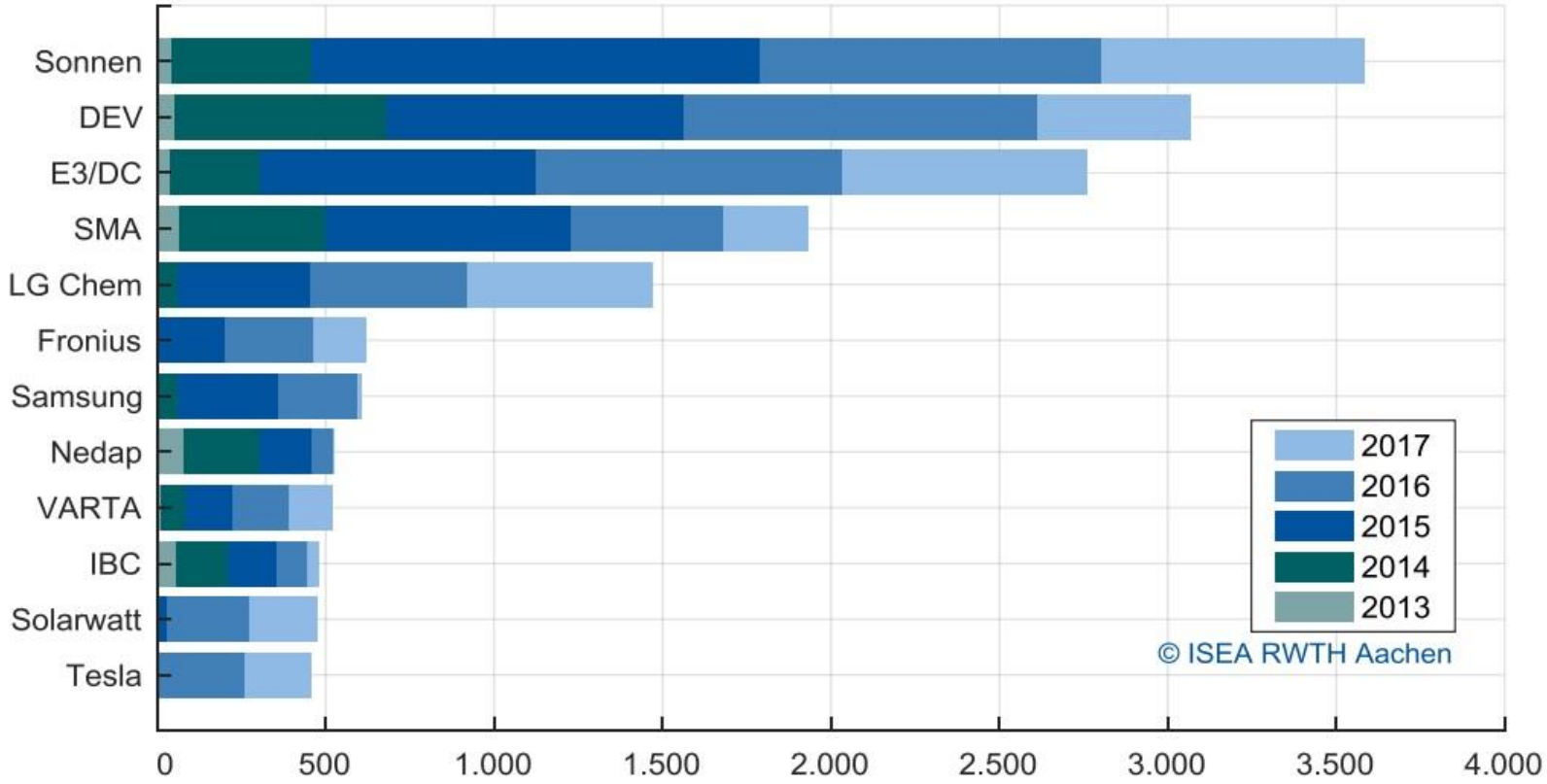
Dataset



Source: O. Schmidt, A. Hawkes, A. Gambhir & I. Staffell. The future cost of electrical energy storage based on experience rates. Nat. Energy 2, 17110 (2017)

Competitive landscape for residential storage systems in Germany

Residential storage systems - Germany

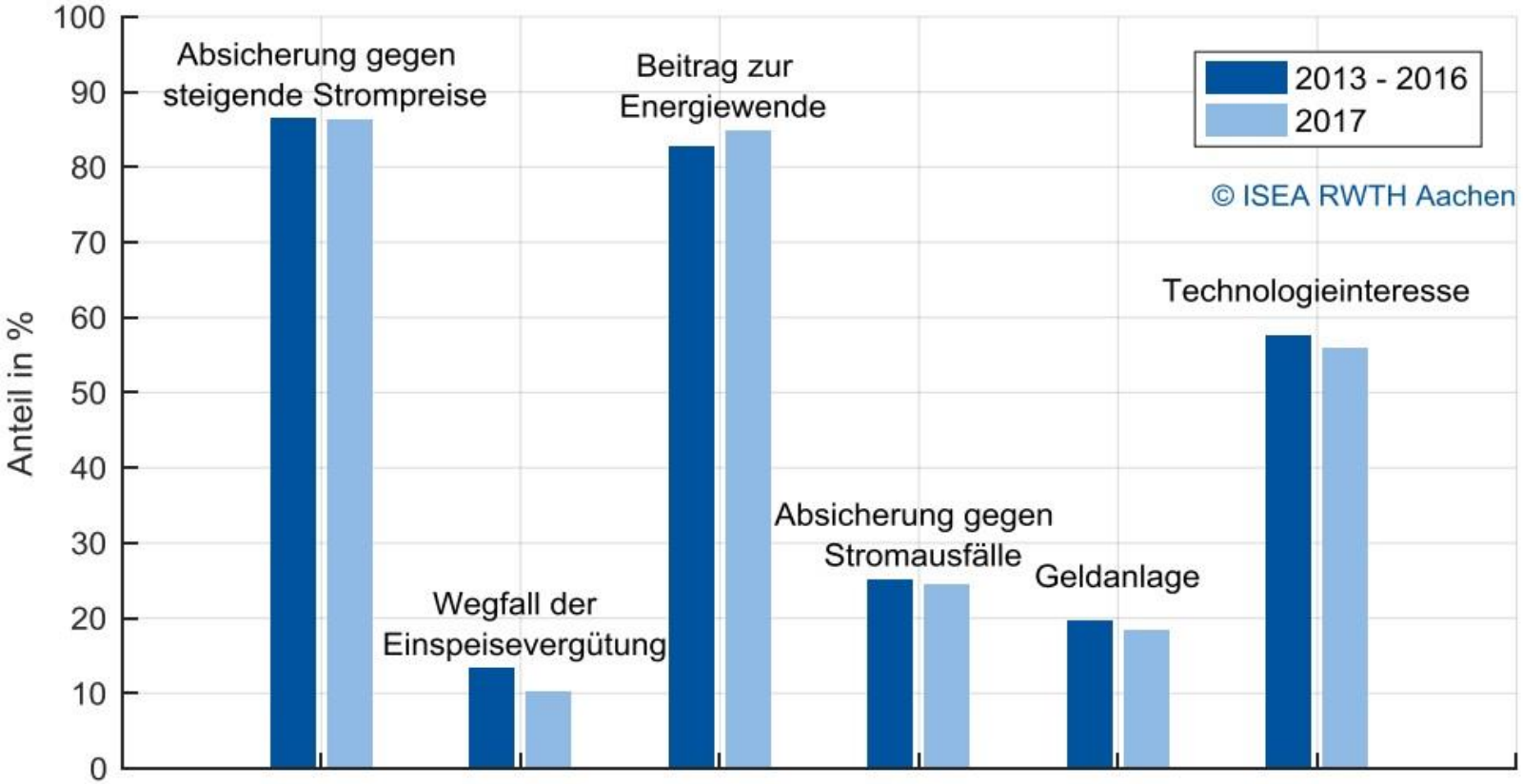


12 manufacturers with most installed storage systems (KfW-registered)

Source: Figgener, J. et al. Wissenschaftliches Mess- und Evaluierungsprogramm Solarstromspeicher. Jahresbericht 2018. Institut für Stromrichtertechnik und Elektrische Antriebe RWTH Aachen

Motivation for residential storage system driven by fear of

Sales drivers



Source: Figgener, J. et al. Wissenschaftliches Mess- und Evaluierungsprogramm Solarstromspeicher. Jahresbericht 2018. Institut für Stromrichtertechnik und Elektrische Antriebe RWTH Aachen

To enable benefit-stacking, low-cost policy measures can be taken

Policy measures

1. Adjust technical standards to open markets for storage technologies (frequency response: reduce minimum bidding sizes, allow assets operating in dispersed fleets)

2. Amend competition regulation to allow combination of value streams (example: regulation in restructured markets like unbundling prohibits simultaneous revenues from generation and transmission)

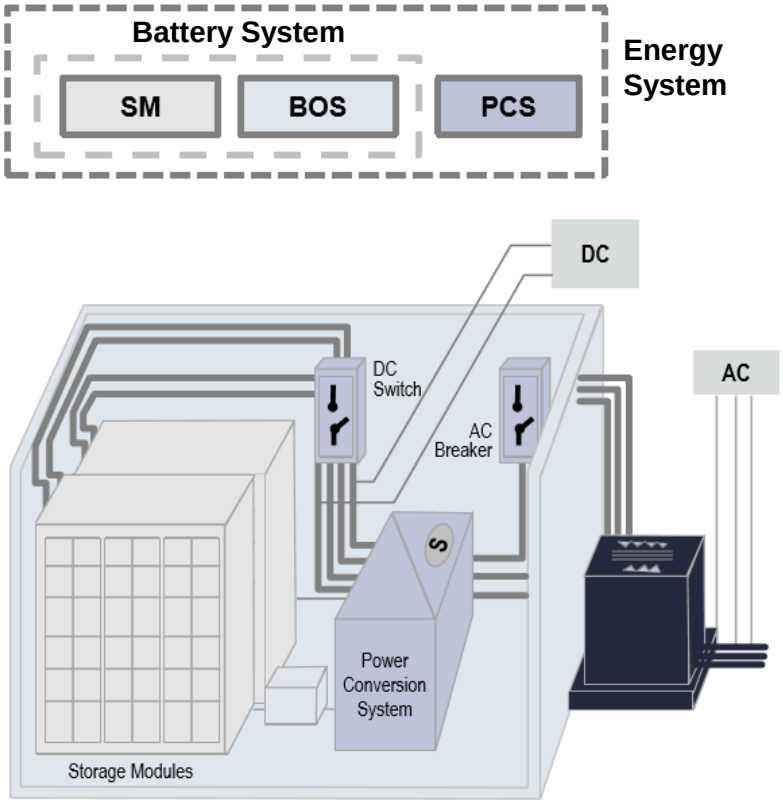
3. Develop consistent legal definition of 'electricity storage' to stipulate that storage can serve as generation, transmission/distribution and consumption support simultaneously

Source: Stephan, A., Battke, B., Beuse, M. D., Clausdeinken, J. H., & Schmidt, T. S. (2016). Limiting the public cost of stationary battery deployment by combining applications. Nature Energy, 1(June), 16079.

Energy storage technologies contain a number of components

Technology components

Physical Energy Storage System



Selected Equipment & Cost Components

System Layer		Component
SM	Storage Module	• Racking Frame/Cabinet • Battery Management System ("BMS") • Battery Modules
BOS	Balance of System	• Container • Monitors and Controls • Thermal Management • Fire Suppression
PCS	Power Conversion System	• Inverter • Protection (Switches, Breakers, etc.) • Energy Management System ("EMS")
EPC	Engineering, Procurement & Construction	• Project Management • Engineering Studies/Permitting • Site Preparation/Construction • Foundation/Mounting • Commissioning
Other (not included in analysis)		• SCADA • Shipping • Grid Integration Equipment • Metering • Land

Source: Lazard's Levelized Cost of Storage Analysis 2017