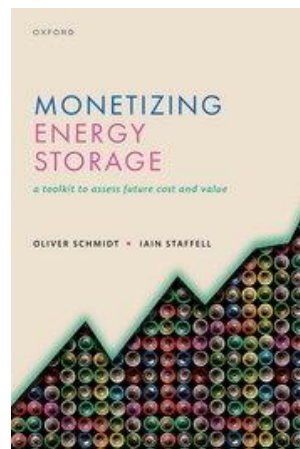
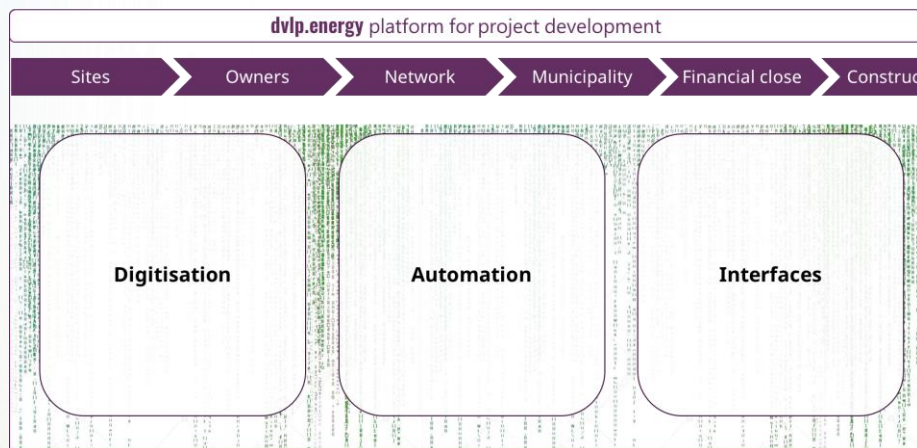


# Monetizing Energy Storage

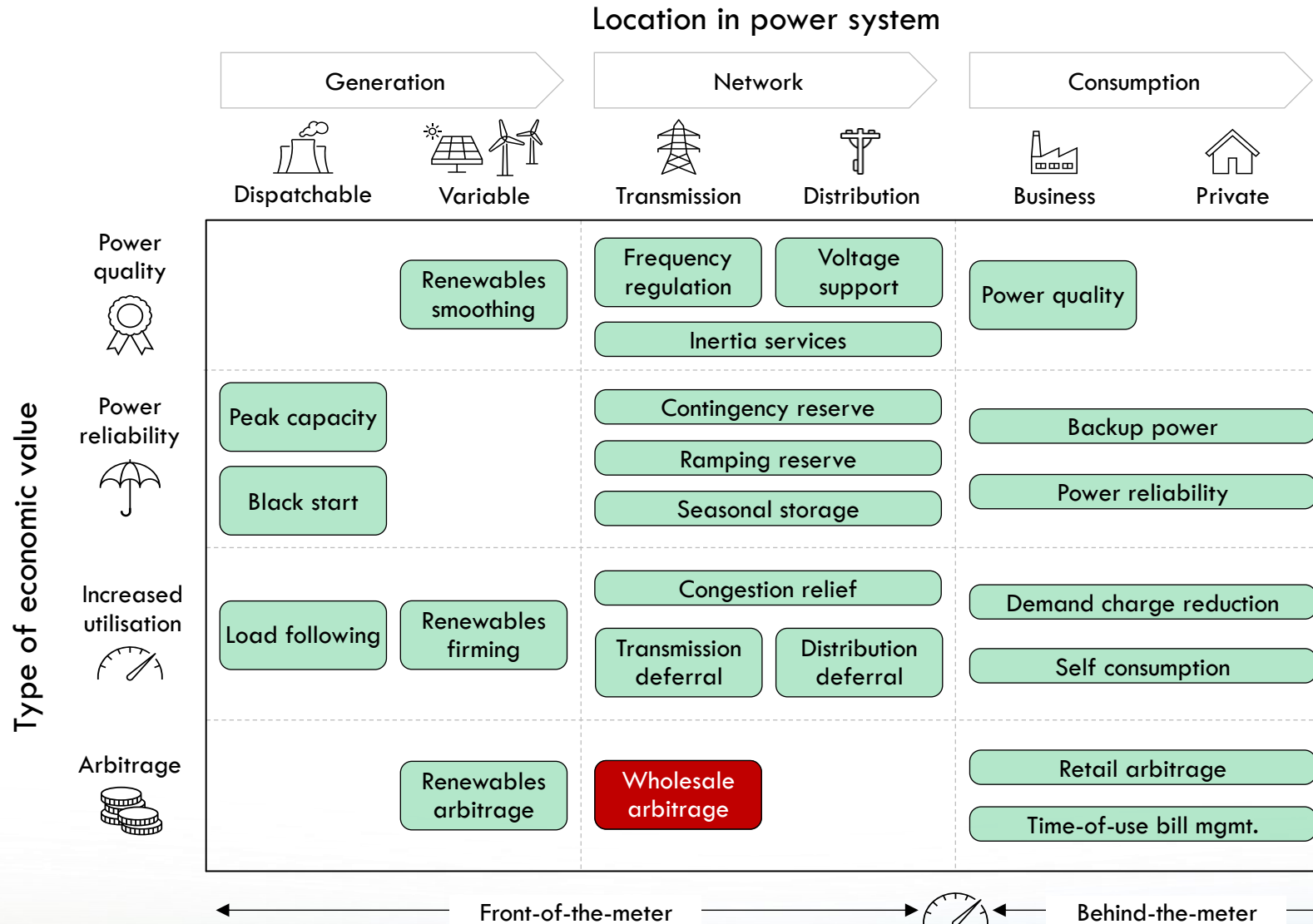
Dr. Oliver Schmidt

**dvlp.energy**

Imperial College  
London



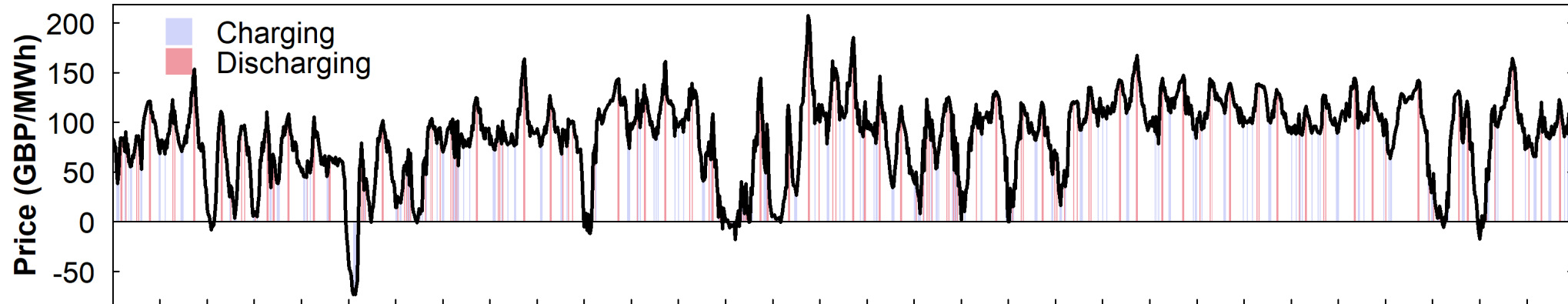
# Arbitrage is one of many storage applications



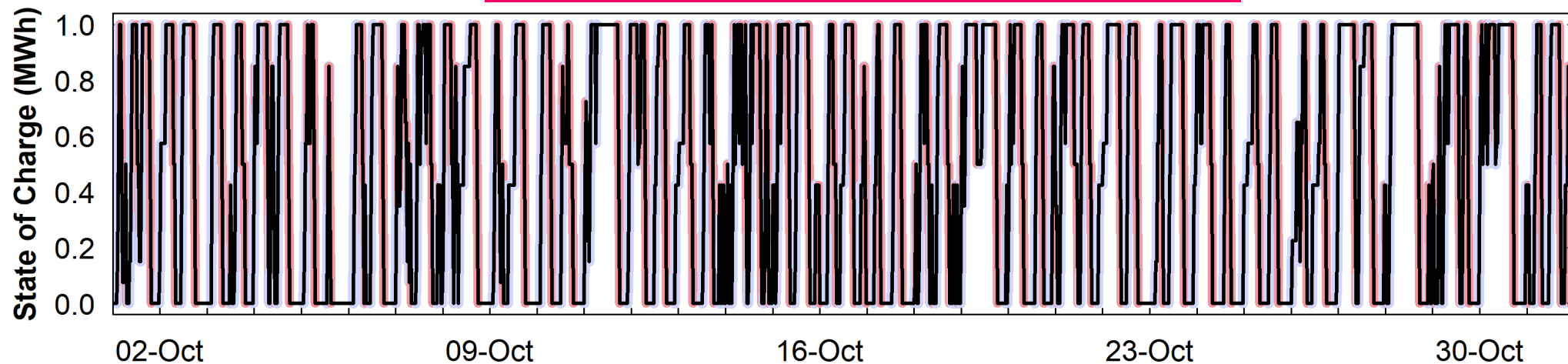
# Big events in wholesale markets are short-lived



## Arbitrage in the GB market



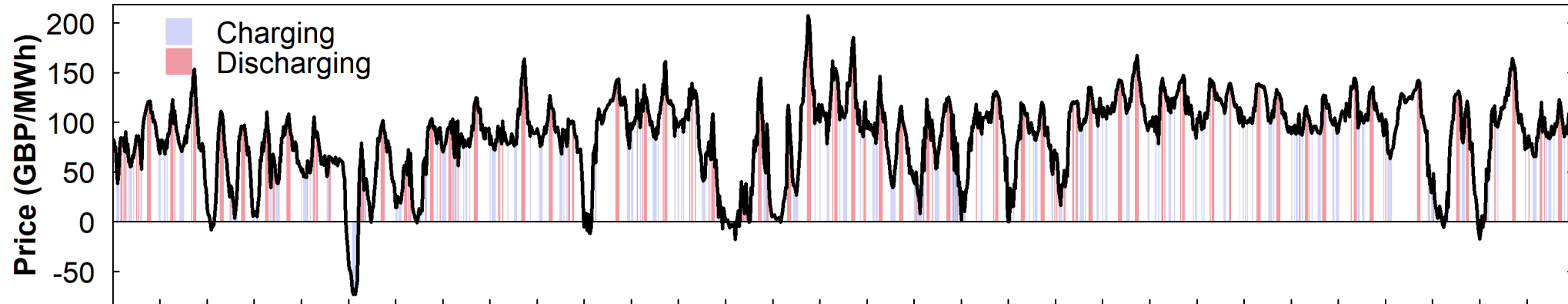
1 hour = 34 £/kW-year



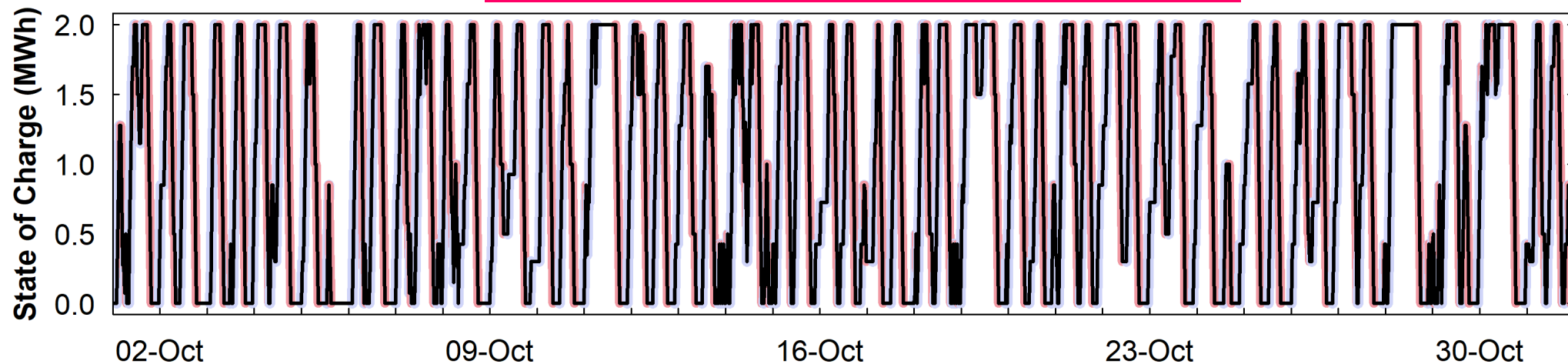
# Big events in wholesale markets are short-lived



## Arbitrage in the GB market



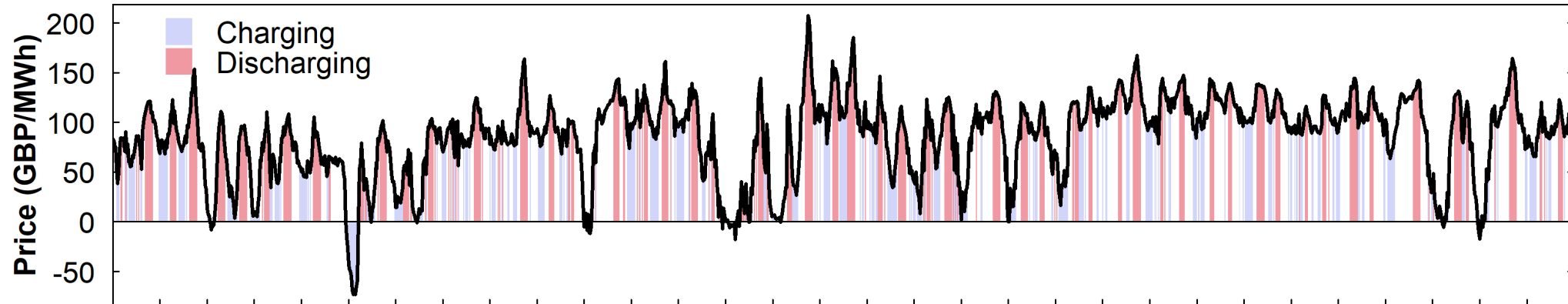
2 hour (+100%) = 56 £/kW-year (+65%)



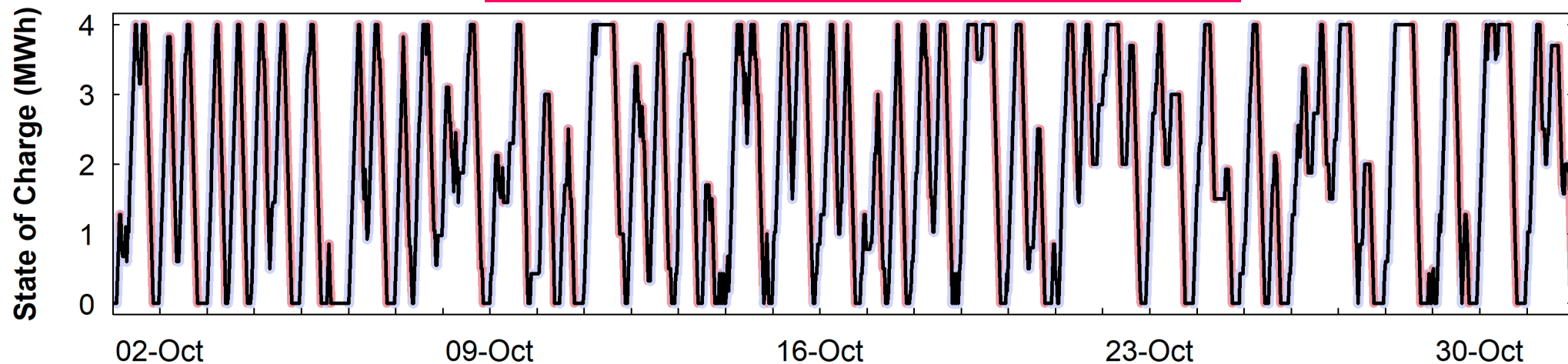
# Big events in wholesale markets are short-lived



## Arbitrage in the GB market



4 hour (+100%) = 84 £/kW-year (+50%)

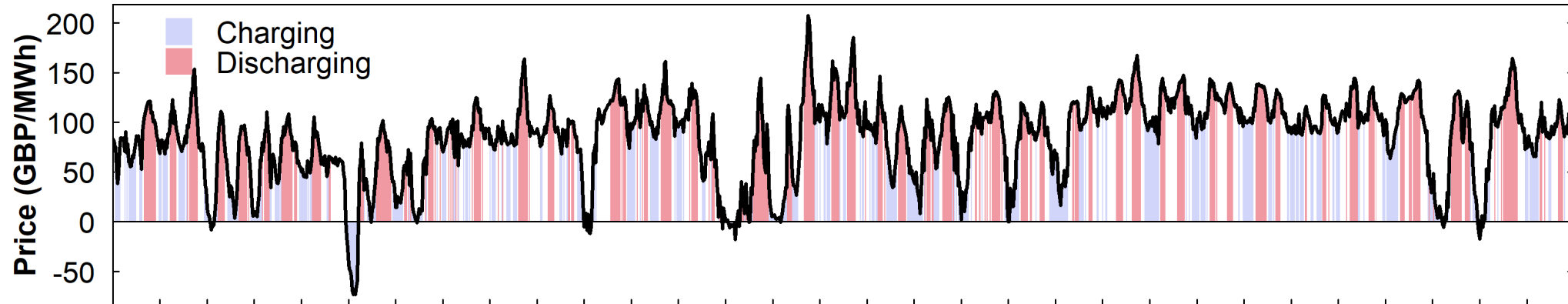




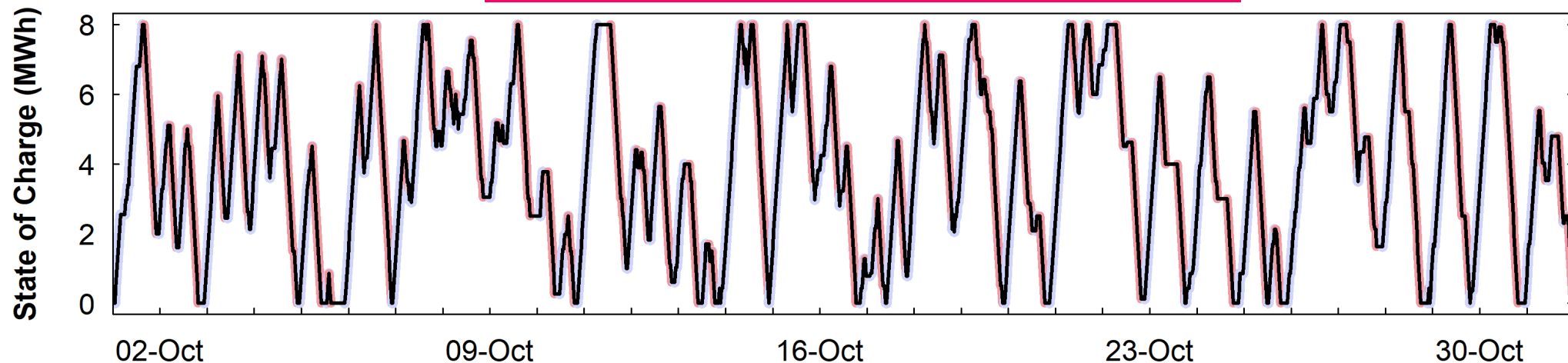
# Big events in wholesale markets are short-lived



## Arbitrage in the GB market



8 hour (+100%) = 106 £/kW-year (+26%)

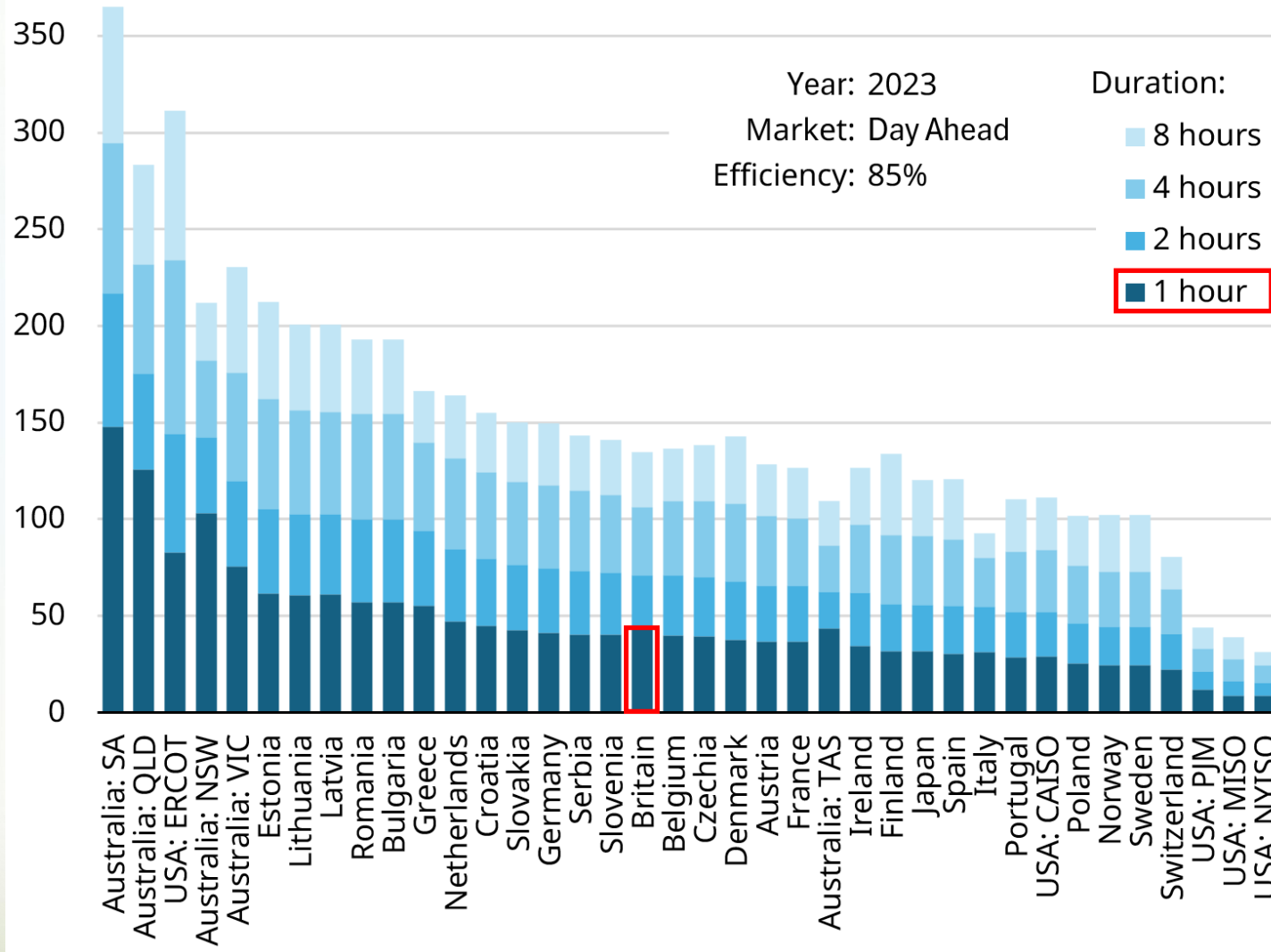


# AUS, TX and Eastern EU are most profitable



Profit: USD / kW / year

[www.EnergyStorage.ninja](http://www.EnergyStorage.ninja)



Key message 1:

**Big events in power wholesale markets are short-lived**

Key message 2:

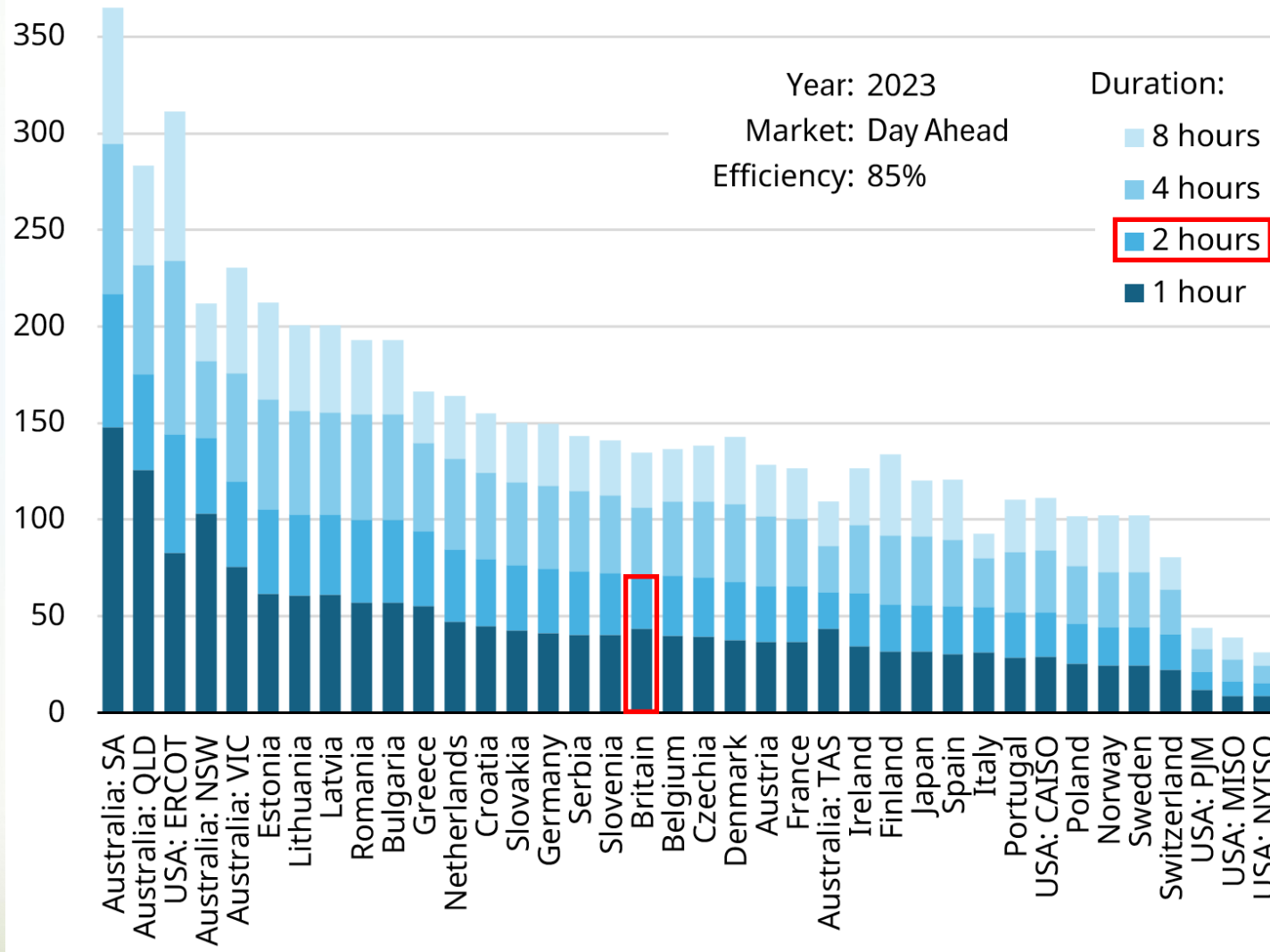
The most profitable day-ahead power wholesale markets are **Australia, Texas and Eastern Europe**

# AUS, TX and Eastern EU are most profitable



Profit: USD / kW / year

[www.EnergyStorage.ninja](http://www.EnergyStorage.ninja)



Key message 1:

**Big events in power wholesale markets are short-lived**

Key message 2:

The most profitable day-ahead power wholesale markets are **Australia, Texas and Eastern Europe**

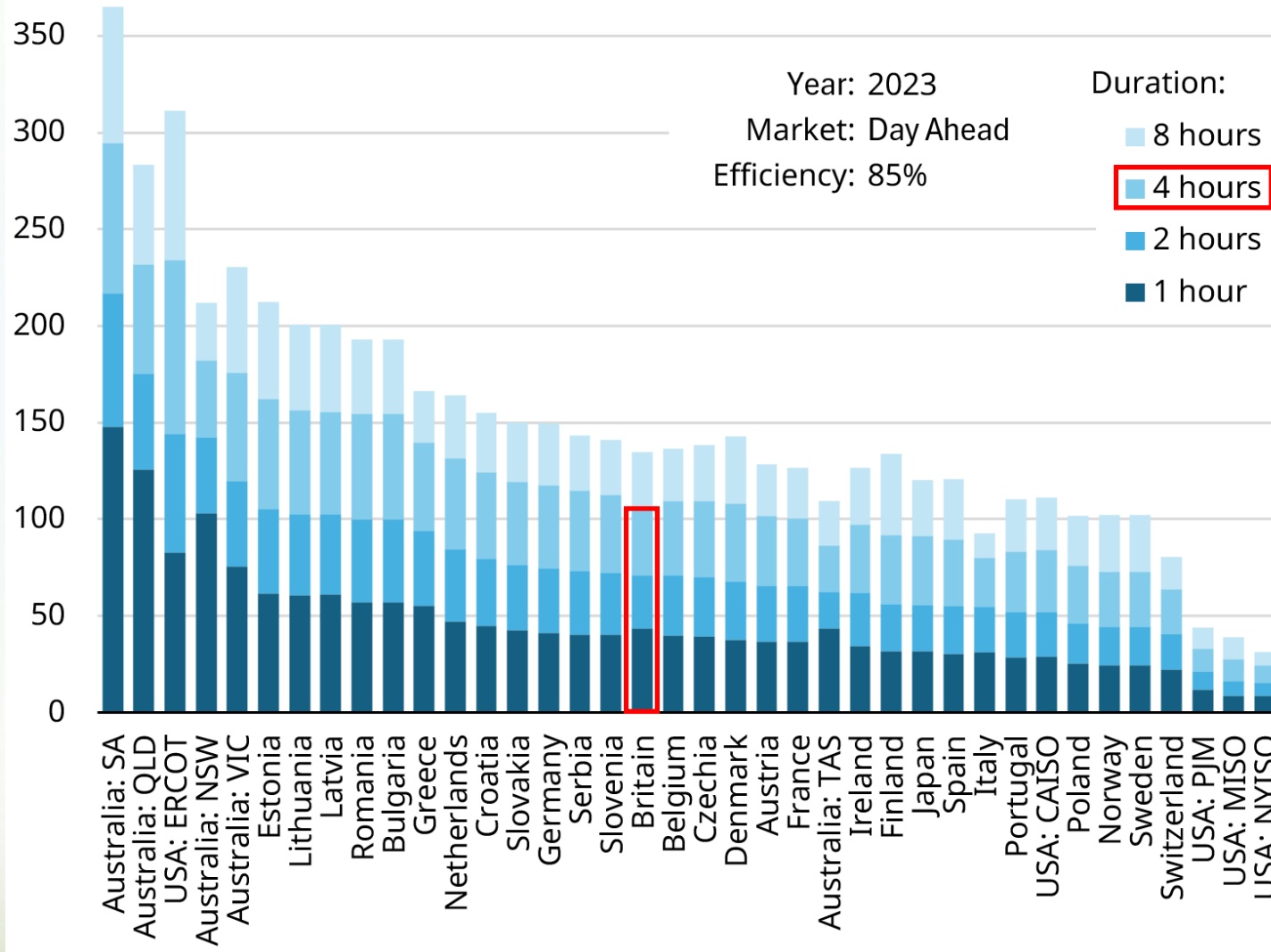


# AUS, TX and Eastern EU are most profitable



Profit: USD / kW / year

[www.EnergyStorage.ninja](http://www.EnergyStorage.ninja)



Key message 1:

**Big events in power wholesale markets are short-lived**

Key message 2:

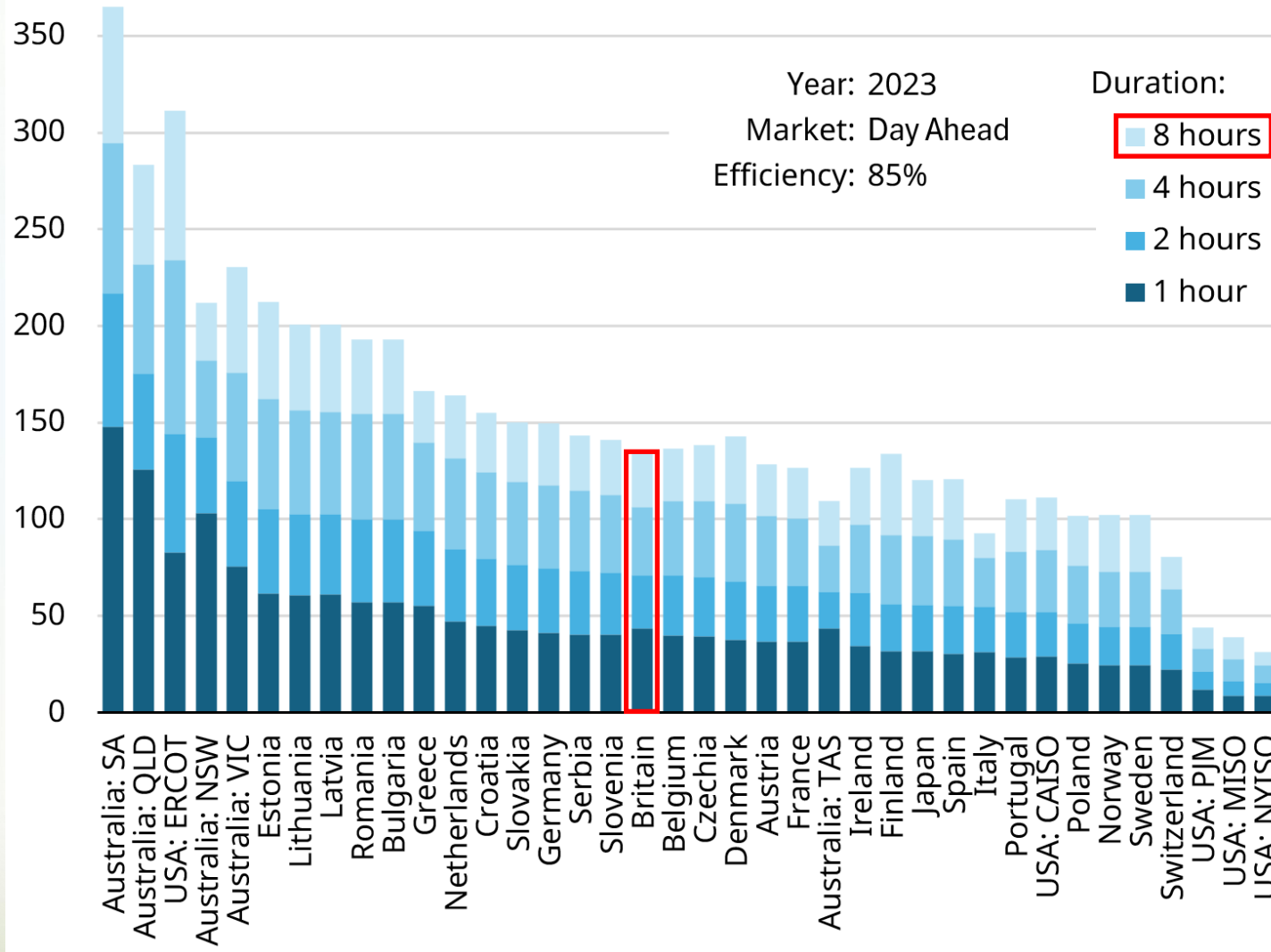
The most profitable day-ahead power wholesale markets are **Australia, Texas and Eastern Europe**

# AUS, TX and Eastern EU are most profitable



Profit: USD / kW / year

[www.EnergyStorage.ninja](http://www.EnergyStorage.ninja)



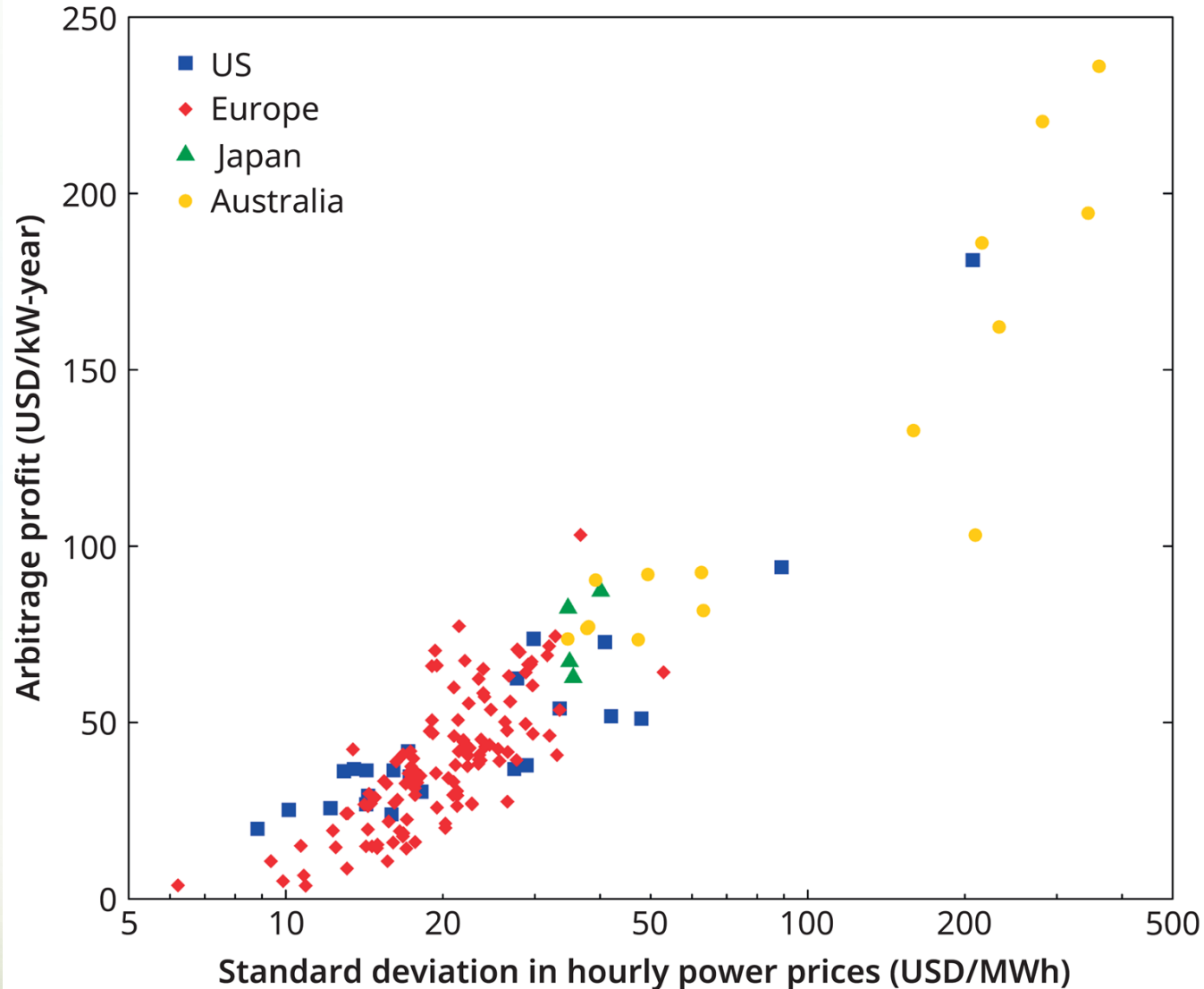
Key message 1:

**Big events in power wholesale markets are short-lived**

Key message 2:

The most profitable day-ahead power wholesale markets are **Australia, Texas and Eastern Europe**

# Revenues are driven by price volatility



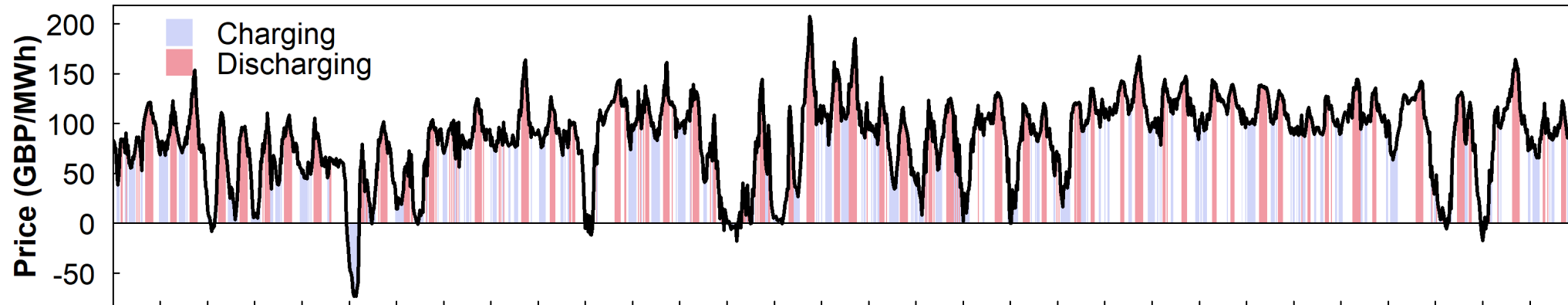
### Key message 3:

**Big and rare events are driven by price volatility, which is quantified as standard deviation in hourly prices**

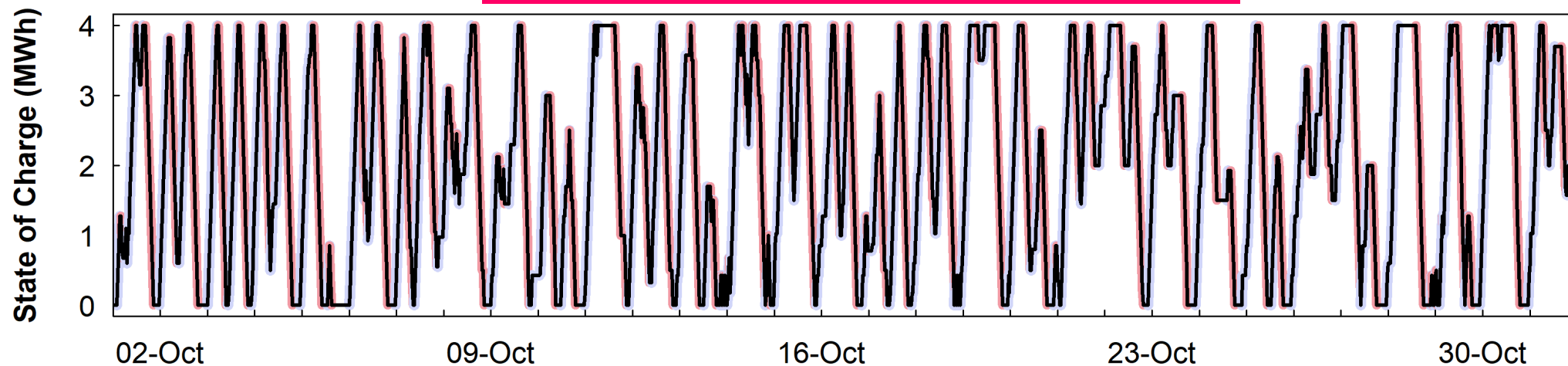
# „Skimming the volatility cream“



## Arbitrage in the GB market



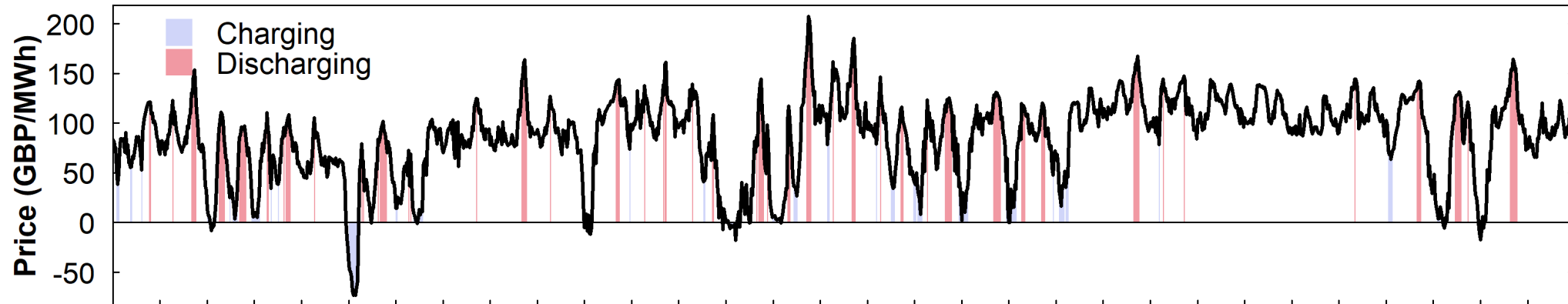
539 cycles (100%) = 84 £/kW-year (100%)



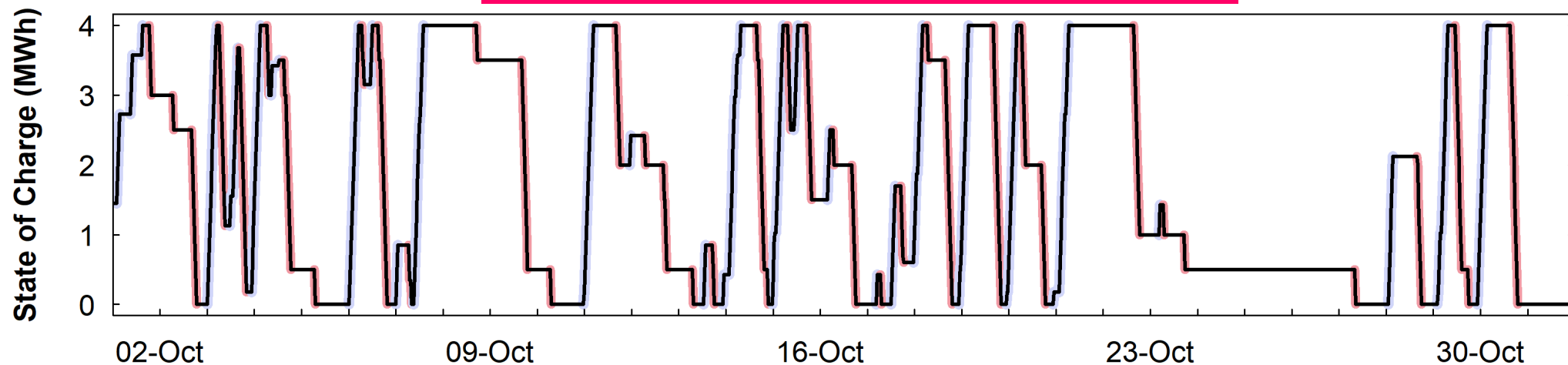
# „Skimming the volatility cream“



## Arbitrage in the GB market



270 cycles (50%) = 72 £/kW-year (87%)

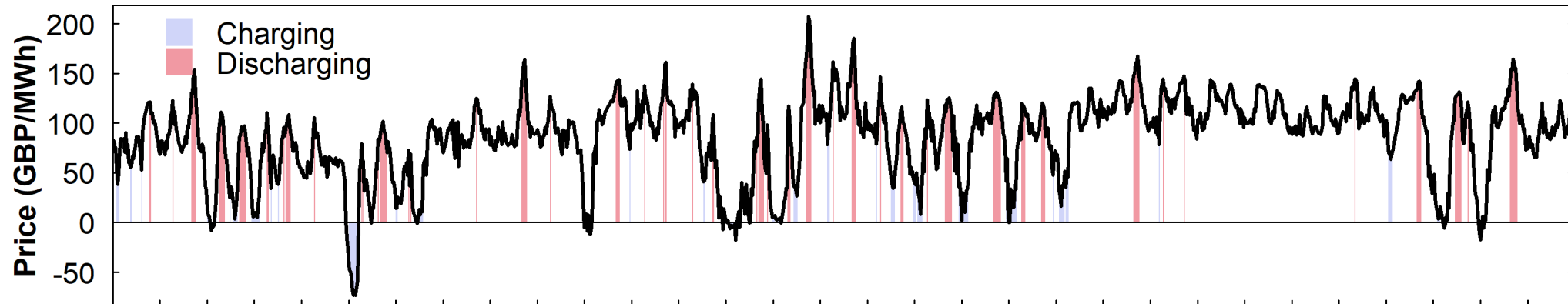




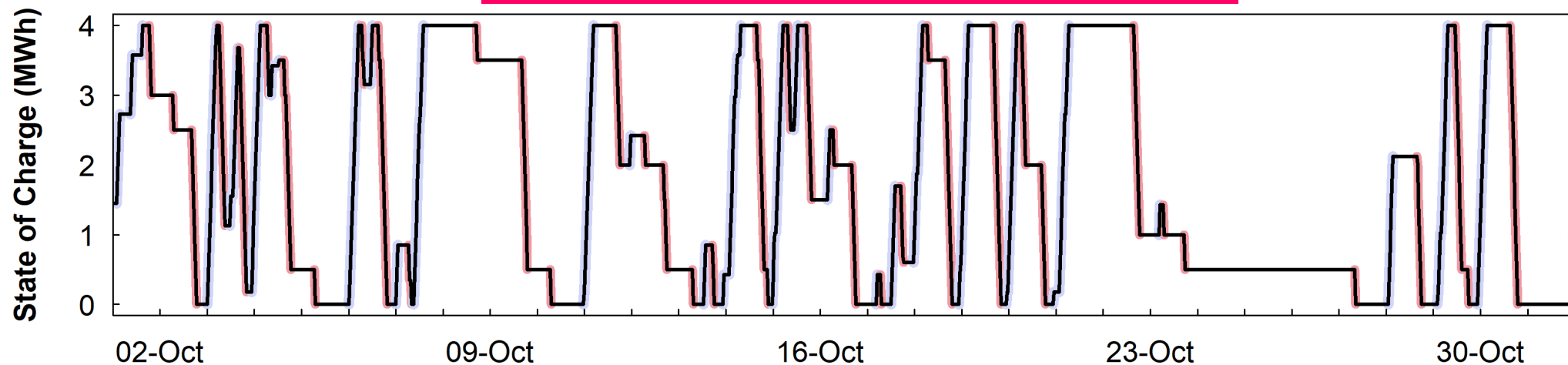
# „Skimming the volatility cream“



## Arbitrage in the GB market



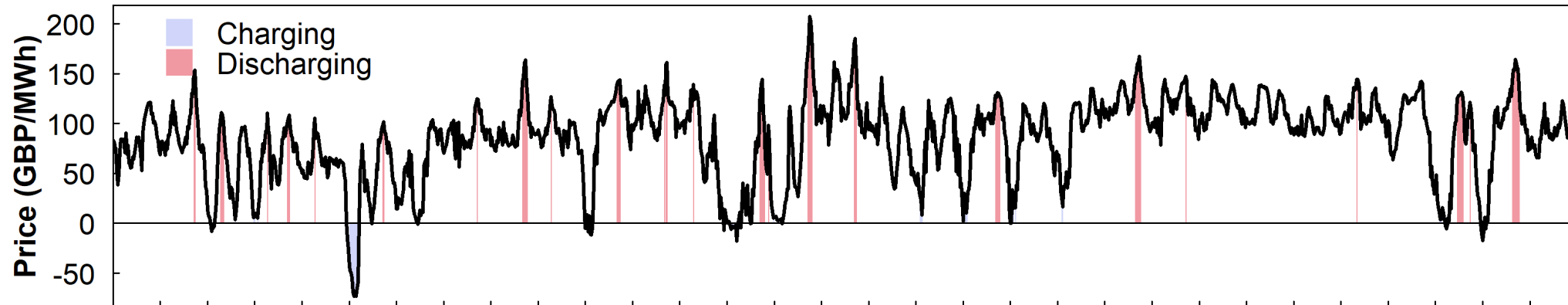
135 cycles (25%) = 54 £/kW-year (65%)



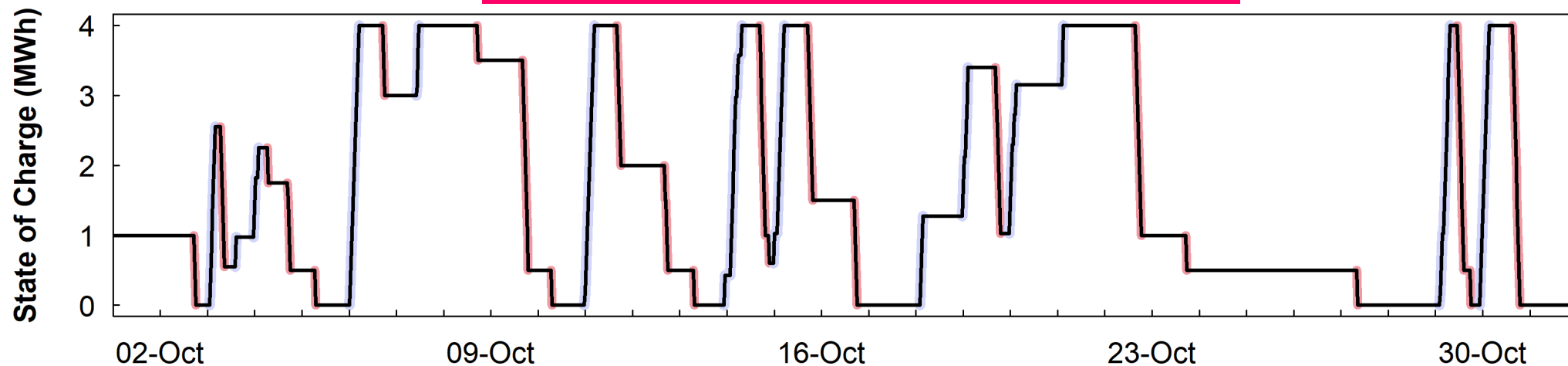
# „Skimming the volatility cream“



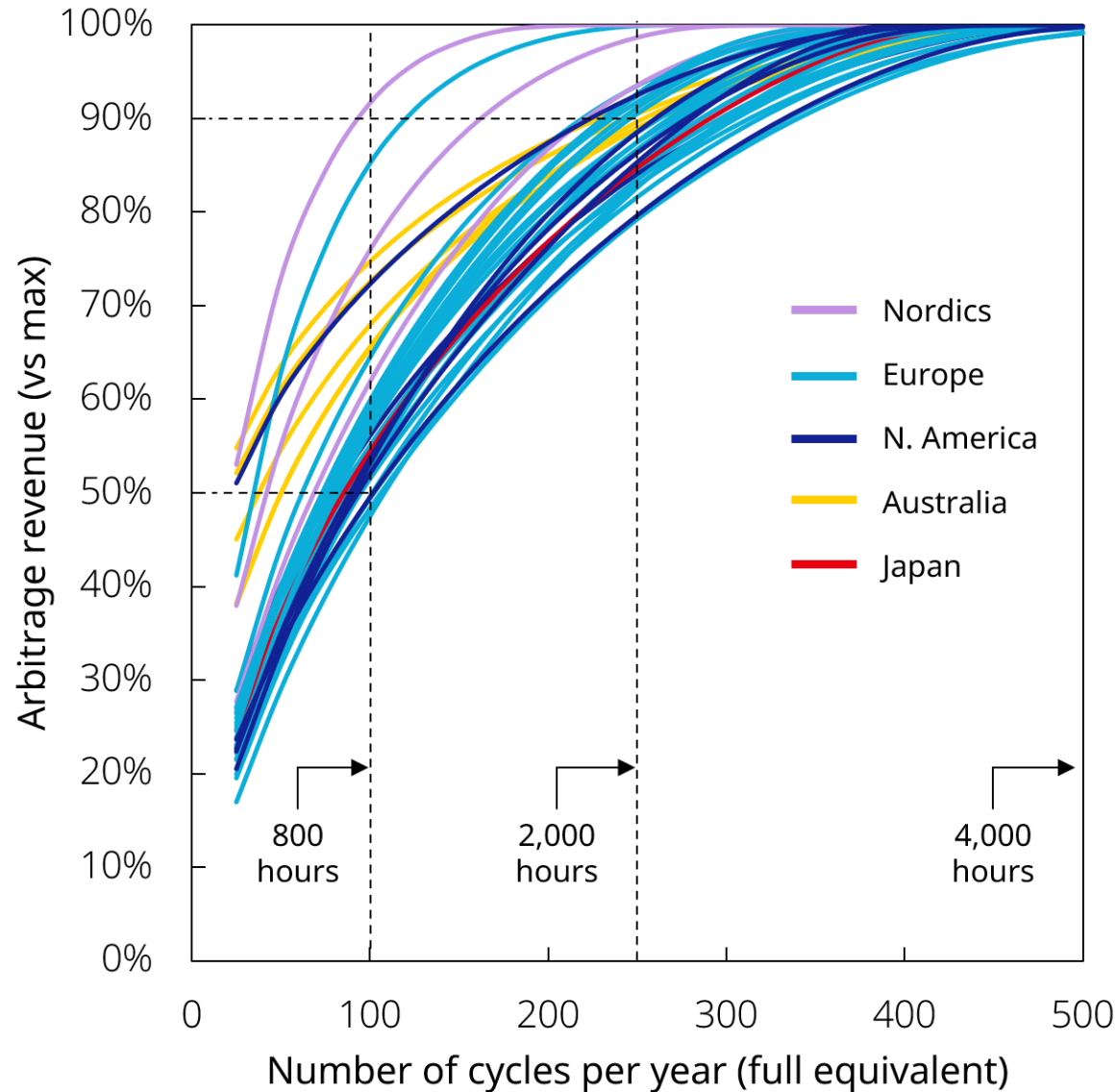
## Arbitrage in the GB market



54 cycles (10%) = 32 £/kW-year (~40%)



# Diminishing returns with more cycles



## Key message 4:

**“Skimming the volatility cream”:** At least 50% of the total value in wholesale markets can be extracted by being active only 10% of the year

# But, there is a first mover advantage



## Day-ahead wholesale power market

