

# Power saving and infrastructure cost and sustainability

April 24, 2024



**SMALLCELLS**  
WORLD SUMMIT



## Circadian Background

# Digitalization to Decarbonize and Decentralize Energy

Energy optimization, analytics, and virtual power platform  
enabled by edge computing  
& wireless sensors

End to end solution for Macro & Micro base stations



### Pre-Commissioning

### Commissioning

### Post-Commissioning

#### Strategic planning to reduce CapEx

- > Right-sized solar and storage designs for new sites based on load analysis

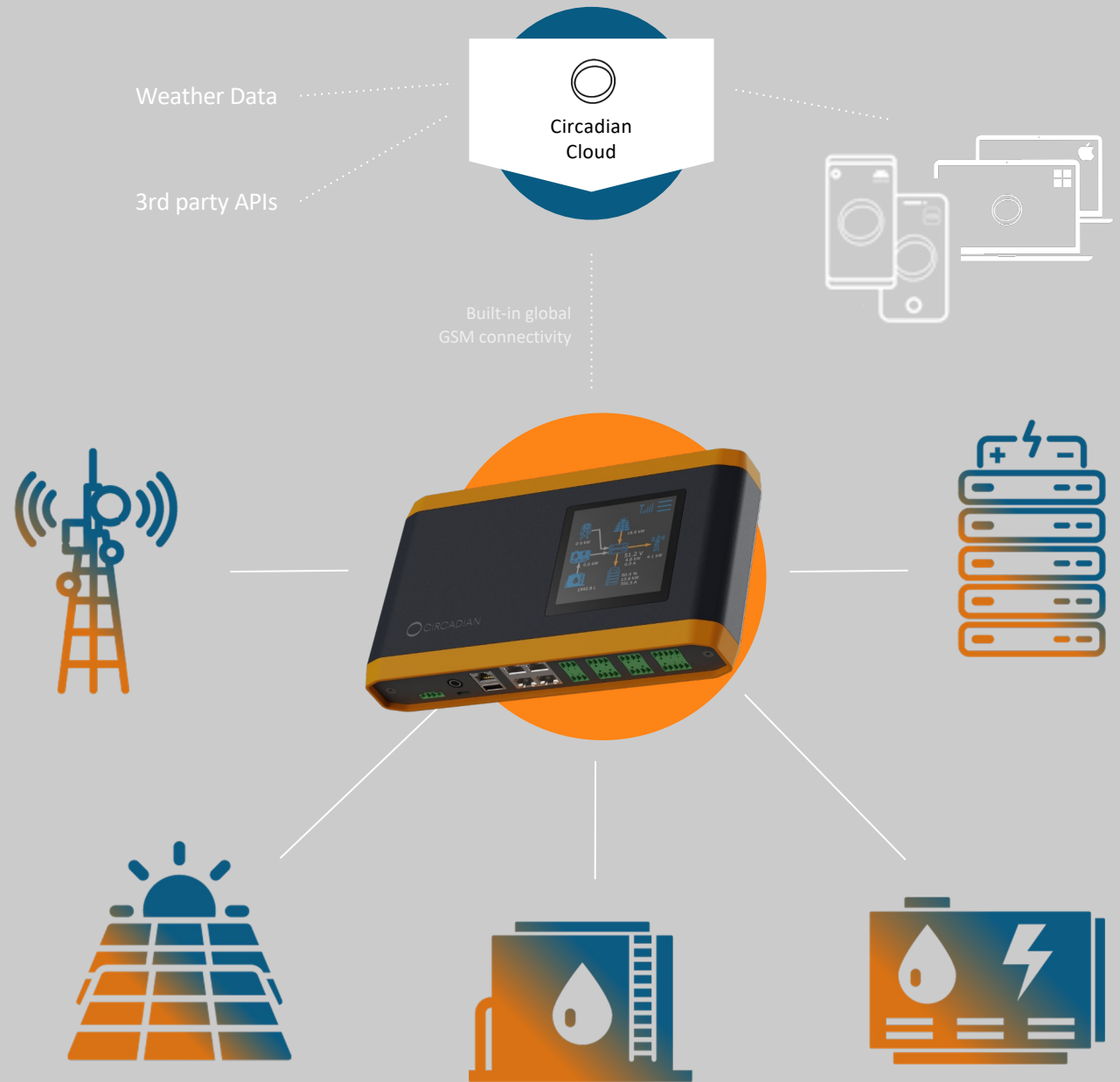
#### Reduce Time to Market

- > Enable Interoperability on site

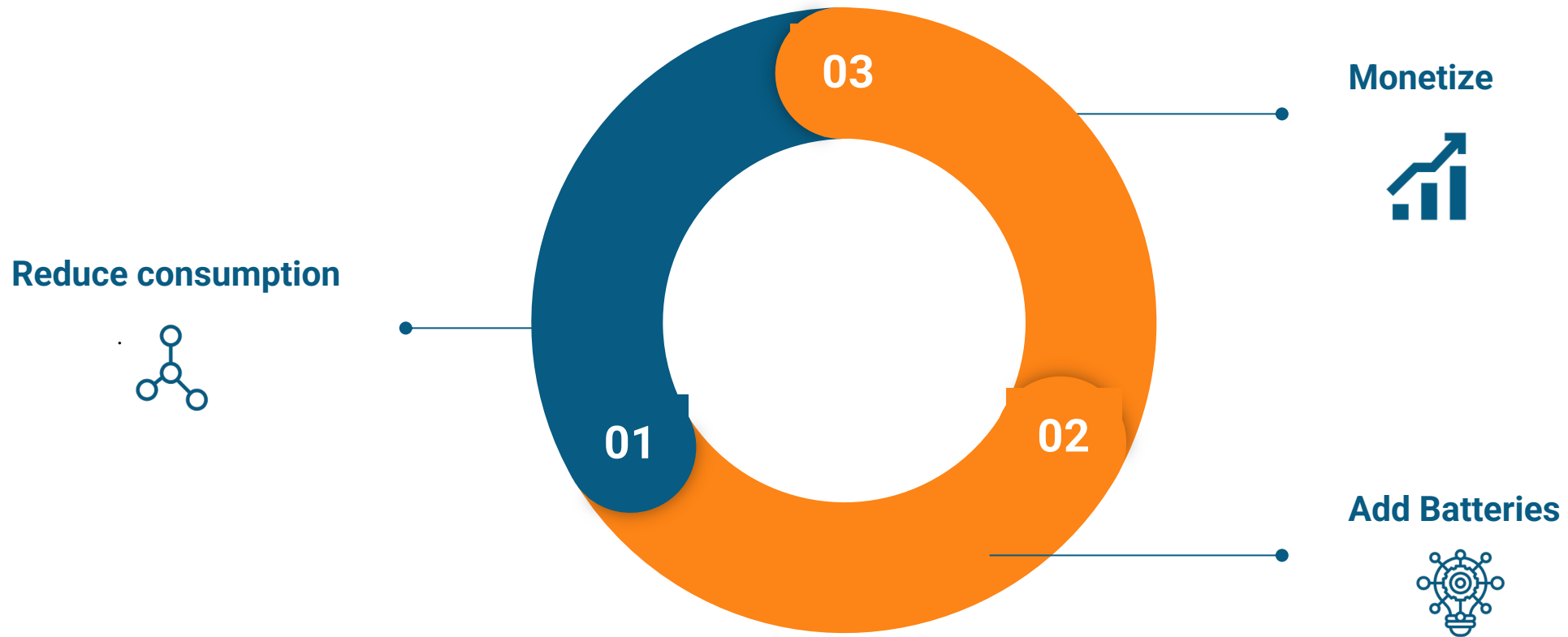
#### Reduce OpEx, Monetize

- > Reduce consumption
- > Enable TOU, Peak Shaving
- > Aggregate to monetize
- > Carbon reporting, RECs





Everything stems from  
DES: Distributed Energy Storage





# Digitalization drives energy efficiency



## 1. Traffic Load Monitoring:

- Continuously monitor the traffic load and user demand within the small cell.
- Calculate the average traffic load  $L(t)$  over a specific time interval.

## 2. Determine Power Adjustment Factor:

- Define a threshold  $T$  that represents the minimum traffic load below which power savings measures are activated.
- Calculate power adjustment factor  $P_{adj}(t)$  based on the traffic load:

$$P_{adj}(t) = \begin{cases} 0.5 & \text{if } L(t) < T \\ 1 & \text{otherwise} \end{cases}$$

- Here,  $P_{adj}(t)$  reduces the transmit power by 50% during low traffic periods.

## 3. Adjust Transmit Power:

- Adjust the transmit power of the small cell based on  $P_{adj}(t)$ :

$$P_{transmit}(t) = P_{normal} \times P_{adj}(t)$$

- Where  $P_{normal}$  is the normal operating transmit power of the small cell.

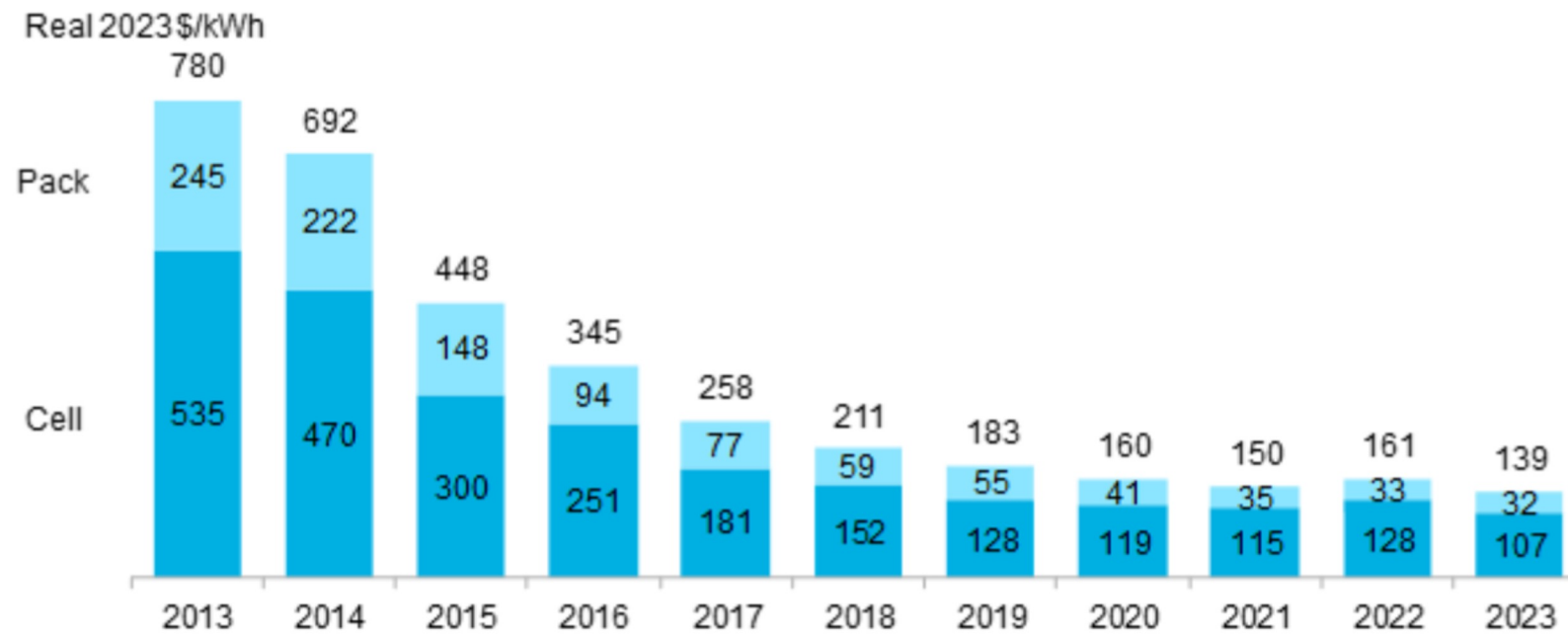
## 4. Energy Consumption Calculation:

- Calculate the energy consumption during both peak and off-peak hours:

$$E(t) = P_{transmit}(t) \times \text{Operating Hours}$$

## Energy storage pricing approaching \$100/kWh

### Volume-weighted avg Li-Ion battery pack and cell price split, 2013-2023



BloombergNEF





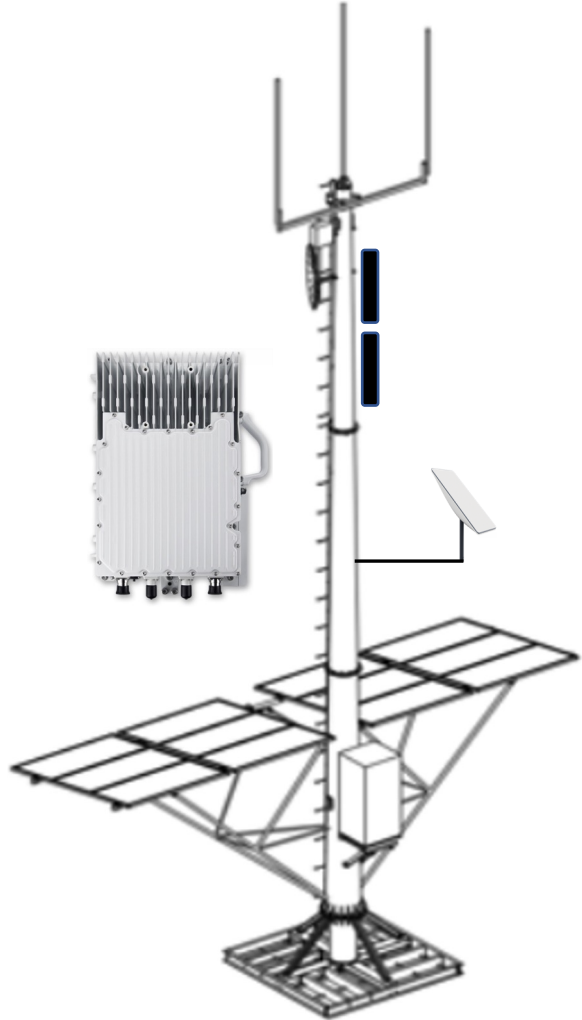
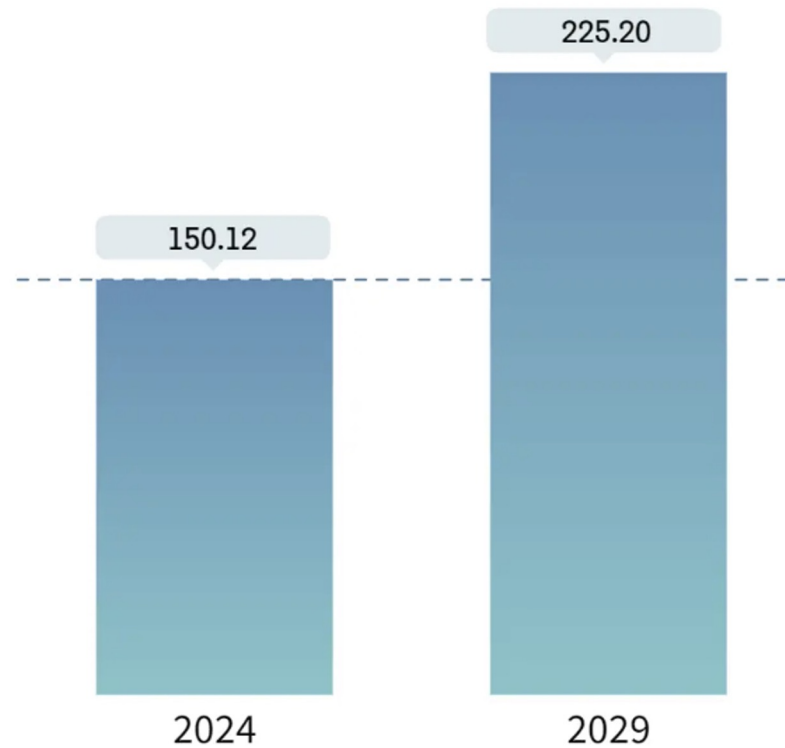
Not just Europe

## Energy storage for resilience in emerging markets

### Africa Small Cell Market

Installed Base in Thousand RUs

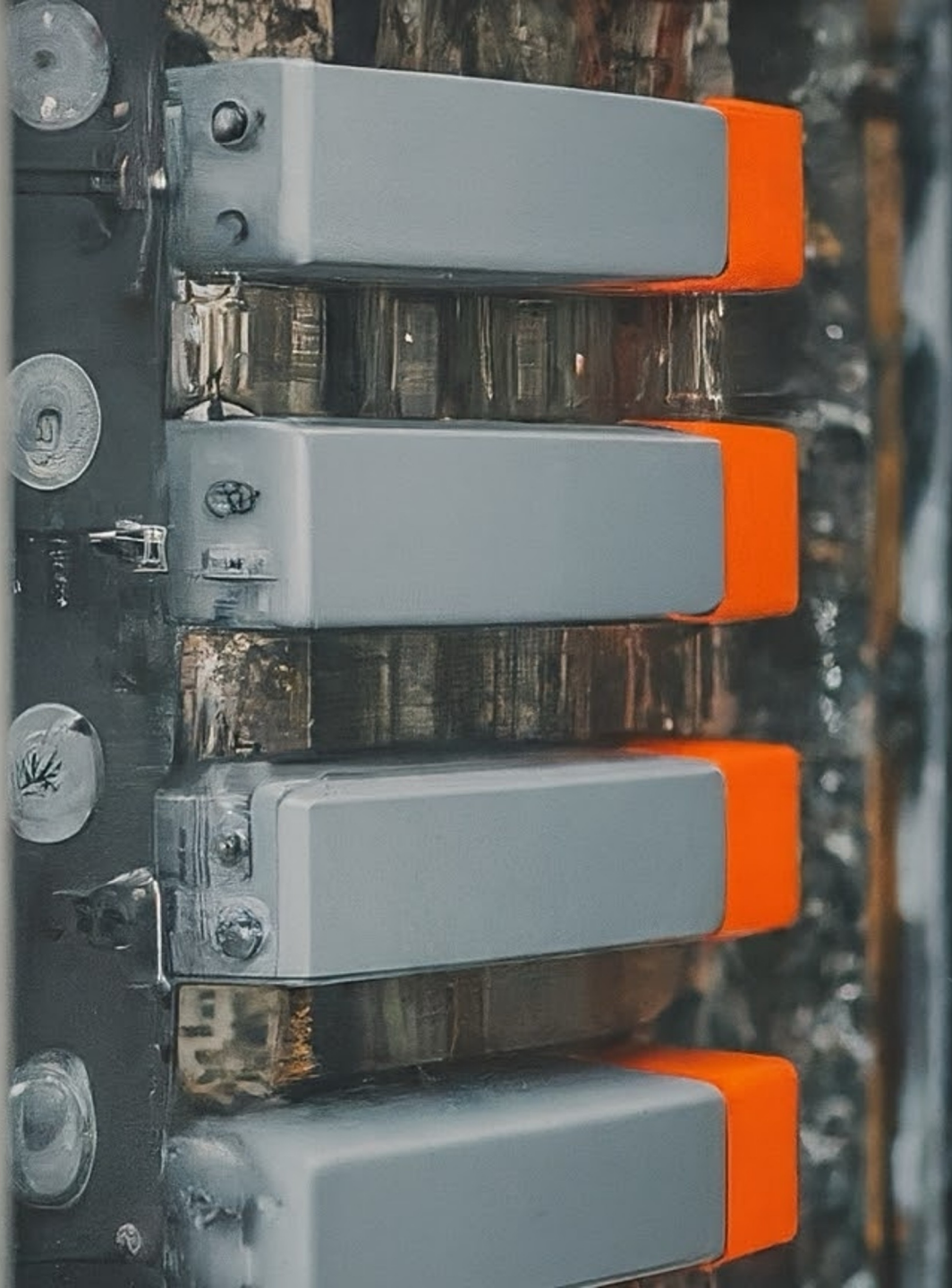
CAGR 8.45%



Source: Megmar International  
Source: Mordor Intelligence  
Source: Circadian x Anglobal







## Digitalization Value Chain

### Electric energy market

- TOU arbitrage
- Spot: day-ahead, day, and real-time trading
- Medium- and long-term: annual and monthly trading

### Ancillary power service market

- Peak shaving market
- Frequency regulation

### Capacity market

- Capacity

Smart Management System





## Example figures

6kWh, 12hr backup

Small Base Station: 500W Consumption

\$700 CapEx

\$120/kWh x 6kWh

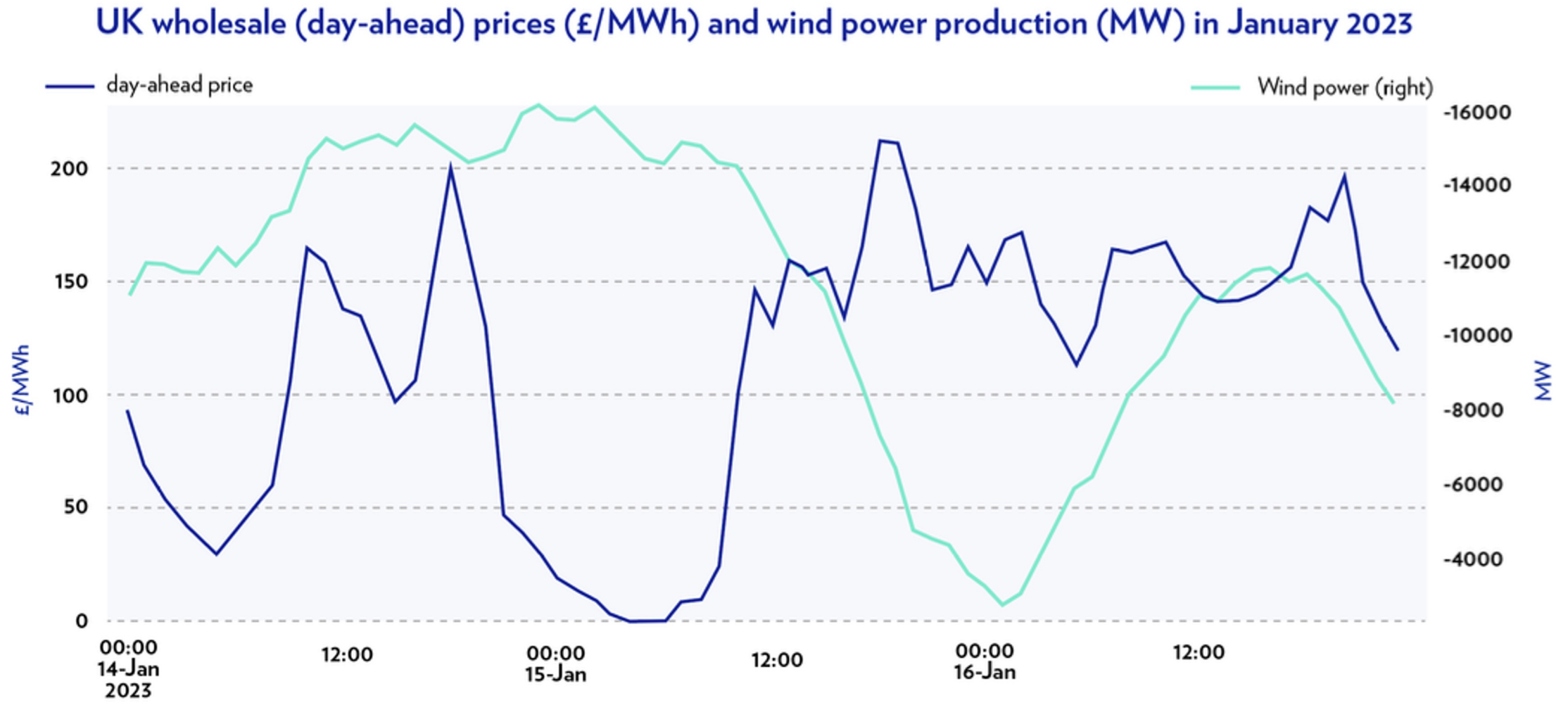
\$438/yr Arbitrage

\$0.15 kWh peak shaving & TOU

44% IRR

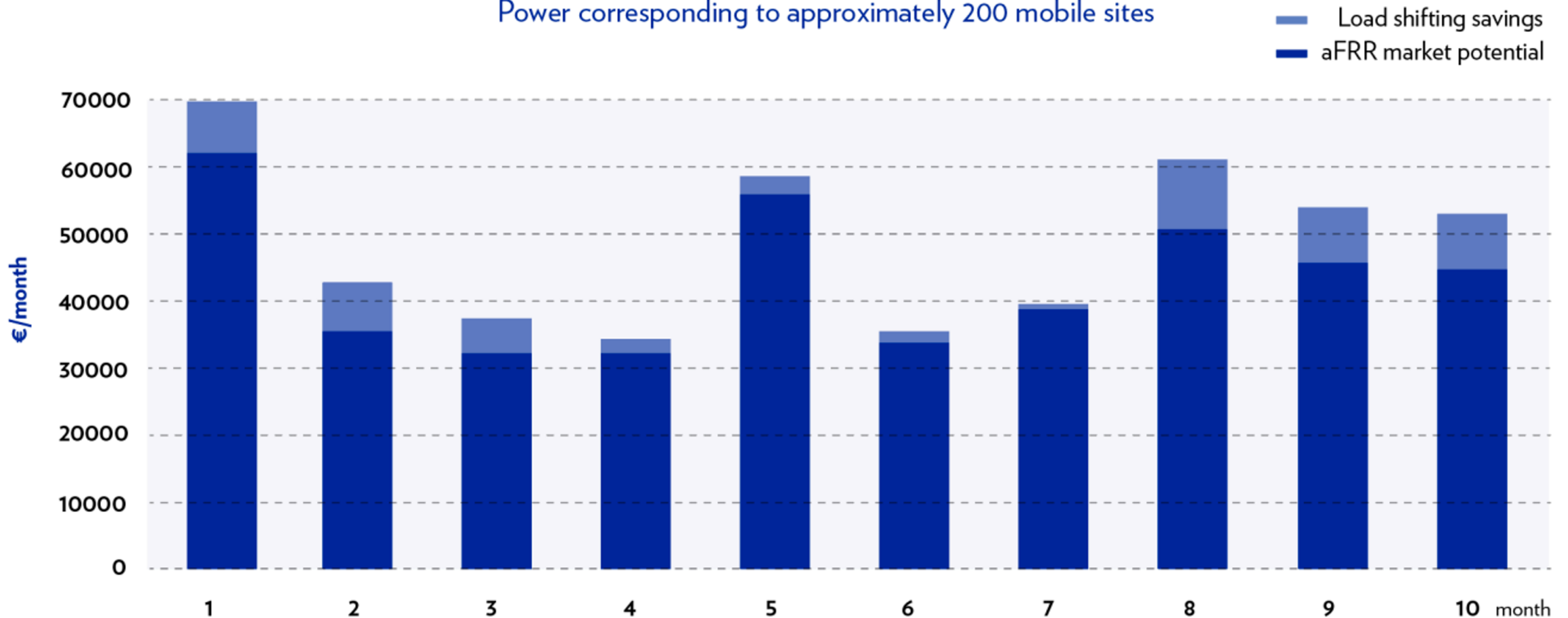
Annualized over 10 yrs

Arbitrage reduces OPEX  
TOU: Time of Use



Macro tower reserve market participation  
aFFR: automatic frequency restoration services

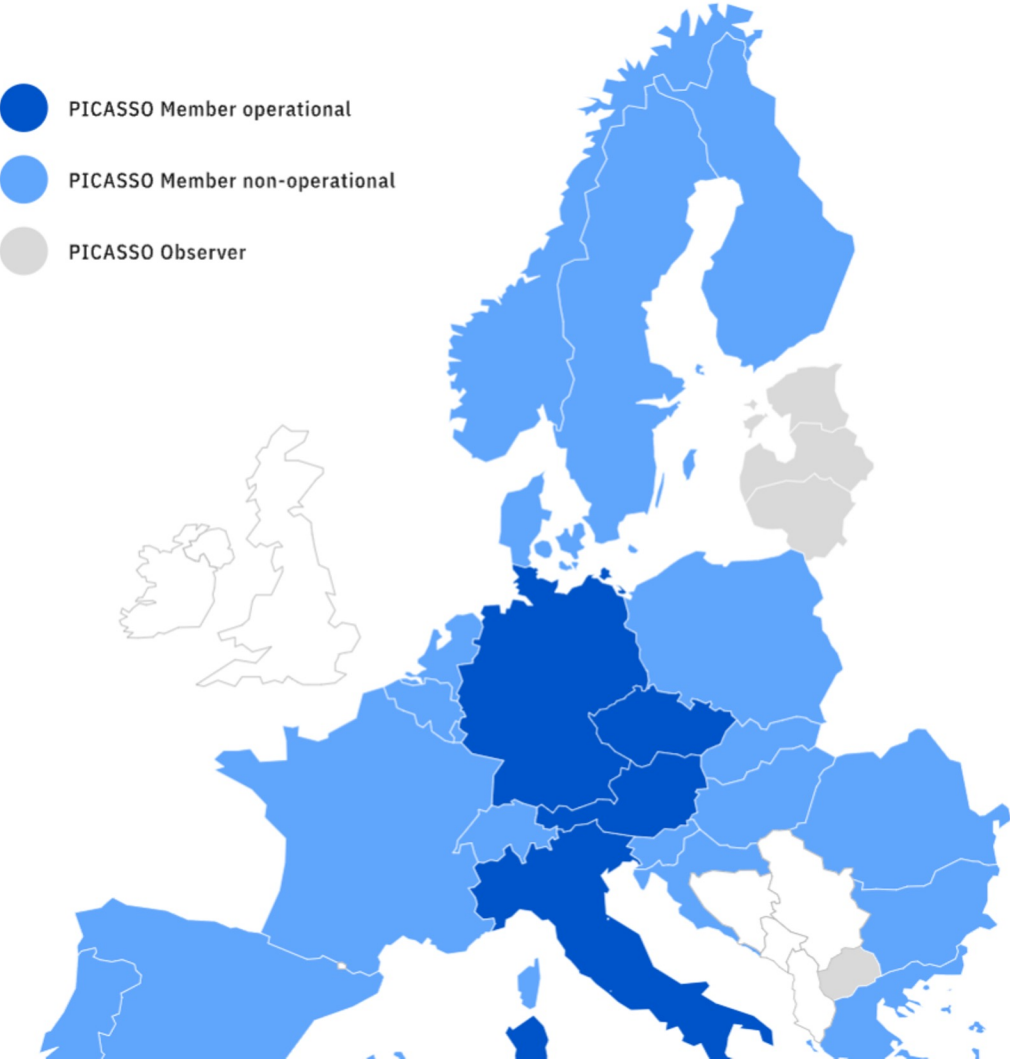
**Monthly revenue potential with 1MW, Finland, 2023**  
Power corresponding to approximately 200 mobile sites





# Enabling negative cost of electricity with Virtual Power Platforms (VPP)

## PICASSO



The Platform for the International Coordination of Automated Frequency Restoration and Stable System Operation (PICASSO) is the implementation project endorsed by all TSOs through the ENTSO-E Market Committee to establish the European platform for the exchange of balancing energy from frequency restoration reserves with automatic activation or aFRR-Platform, pursuant to Article 21 of the Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing (EB GL).

## Carbon Credits, RECs No longer the wild west



# Questions?

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