

# Balancing the grid: The role of BESS in ancillary services



Your speaker today

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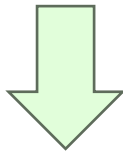
01. Introduction
02. Types of Ancillary Services
03. BESS for Ancillary Services
04. BESS for Frequency Regulation
05. Future Trends
06. BESS in Iberia Blackout

# 1. Introduction

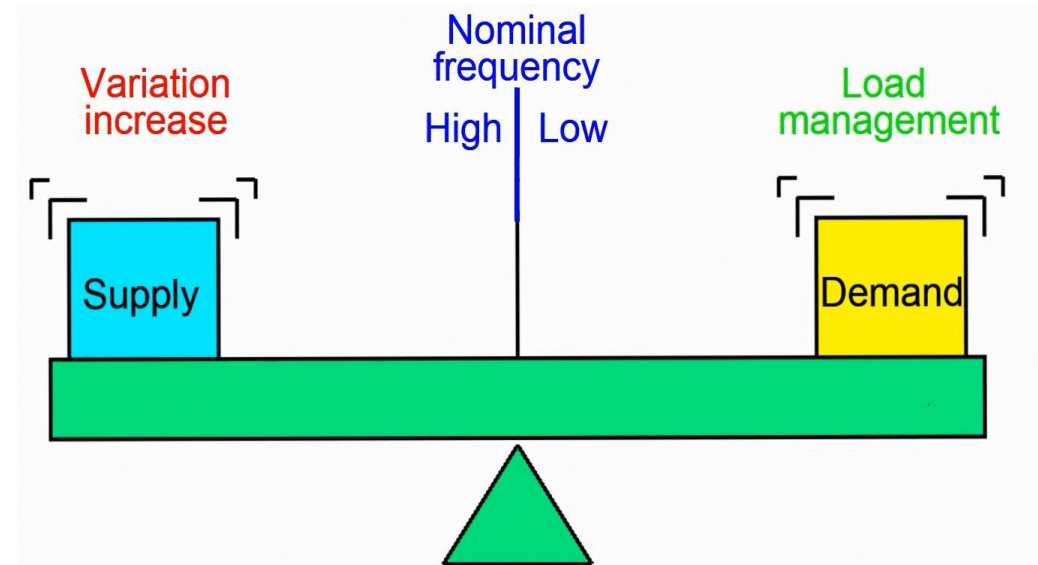
## Introduction

Grid stability refers to the power system's ability to:

1. Maintain a constant frequency, voltage, and power flow equilibrium
2. Recover quickly from disturbances



**Ancillary Services**

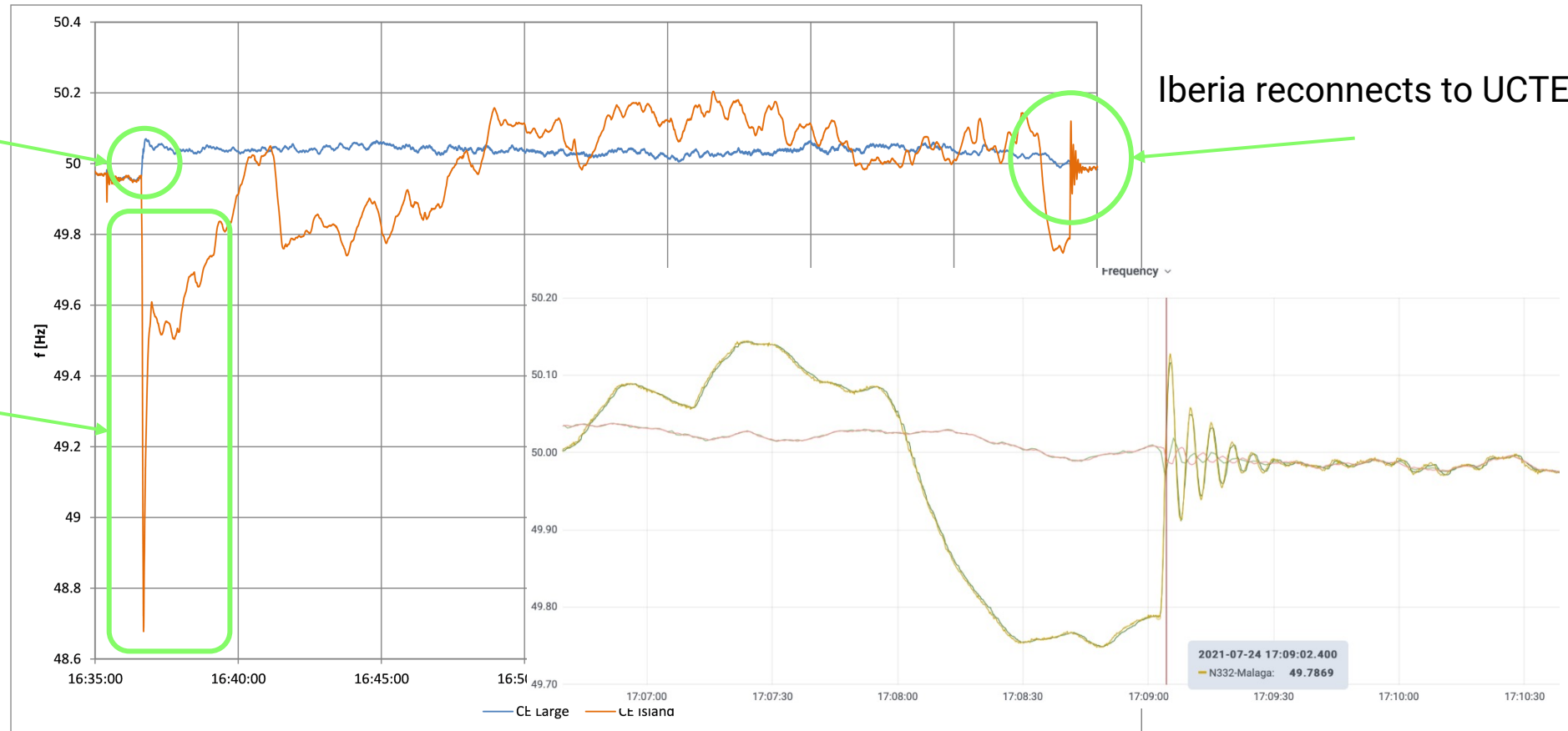


## Outage of French-Spain interconnection (24<sup>th</sup> July, 2021)

France-Spain disconnect  
~2500MW lost

FCR and load shedding

Iberia reconnects to UCTE



Source: Entsoe

<https://www.entsoe.eu/news/2021/08/20/outage-of-french-spanish-interconnection-on-24-july-2021-update/>

## 2. Types of Ancillary Services



## Types of Ancillary Services

### Frequency Regulation

Keeps frequency stable  
adjusting active power

### Voltage and Reactive Power Control

Regulates voltage using  
reactive power

### Operating reserves

Provides backup power for  
sudden imbalances

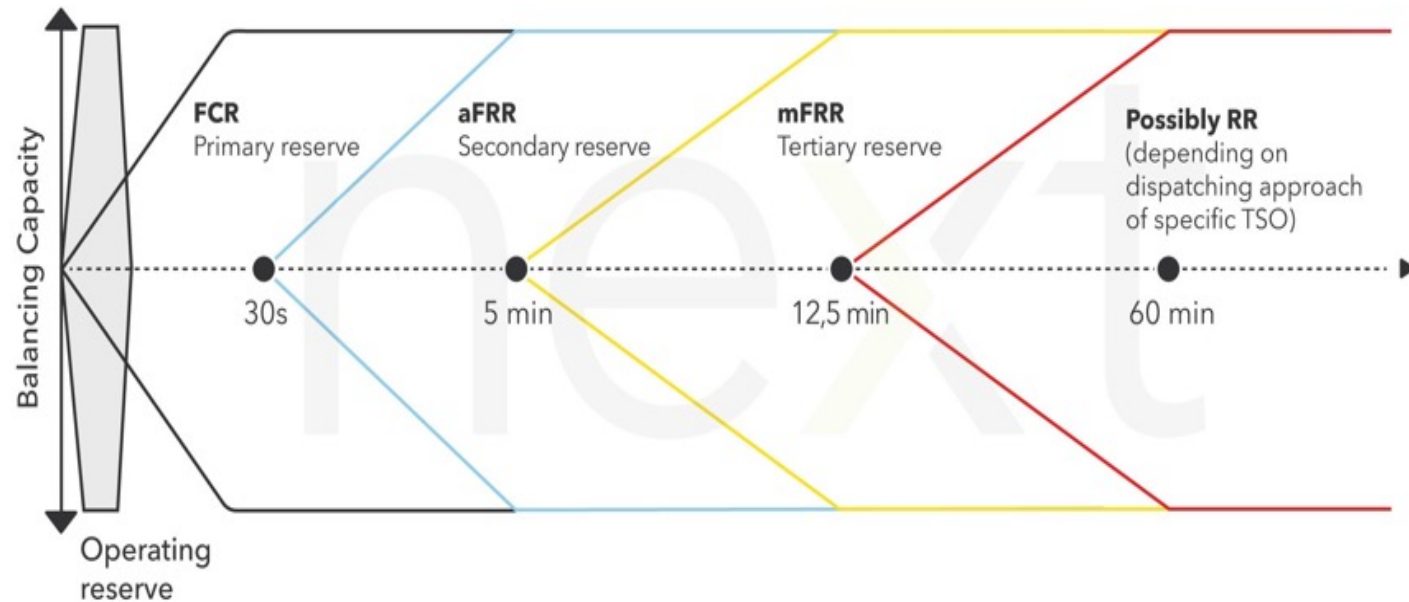
### Black Start Capability

Restarts the grid after a  
blackout



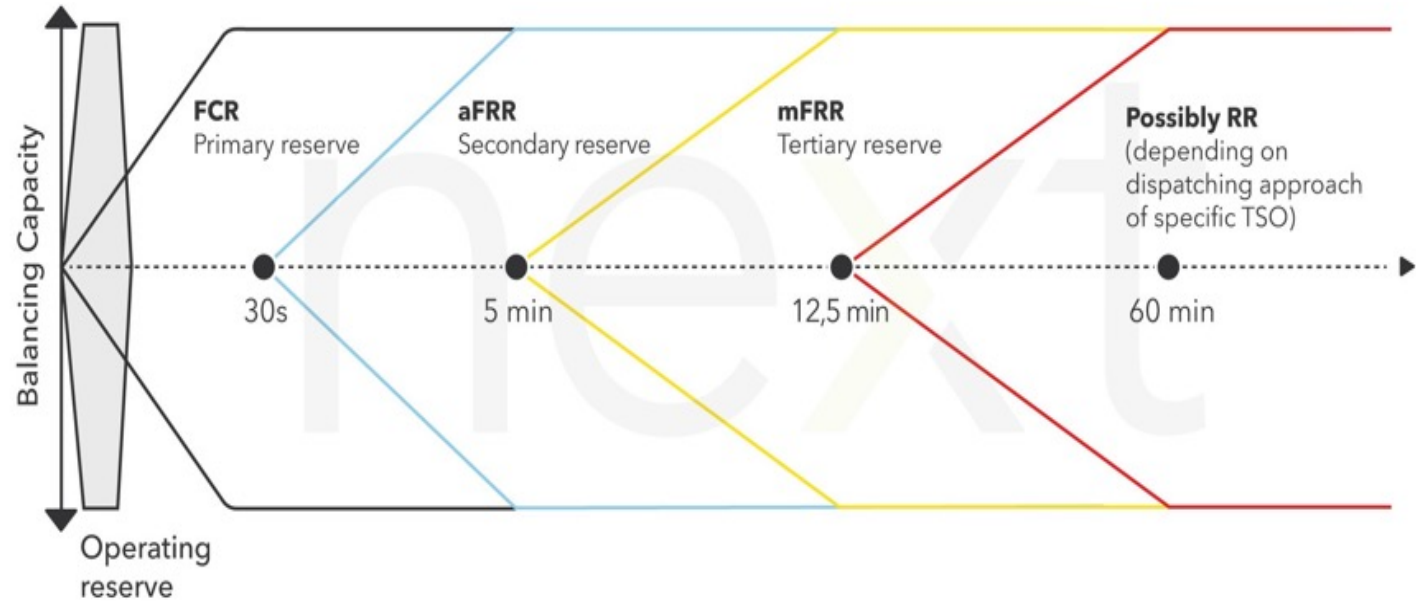
# Frequency Regulation

- **FCR (Primary reserve):**
  - Immediate
  - Automatic
- **aFRR (Secondary reserve):**
  - Up to 5 minutes
  - Automatic
- **mFRR (Tertiary reserve):**
  - Up to around 15 minutes
  - Manual
- **RR (Replacement reserve):**
  - Until frequency is stable
  - Manual
  - Can be “spinning” or “non-spinning”



## FCR (Frequency Containment Reserve)

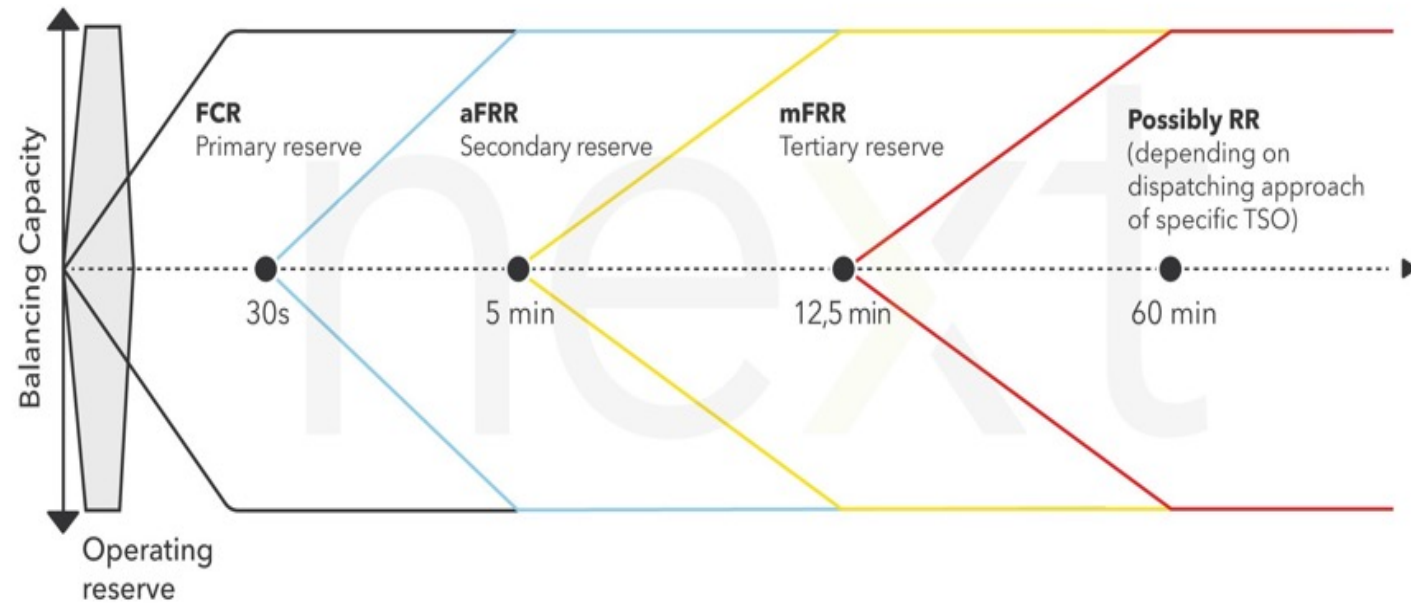
- Contains frequency immediately
- Full activation ~30 seconds
- Up to 15 minutes
- Automatic
- Part of the capacity market



## Types of Ancillary Services

### aFRR (Automatic Frequency Restoration Reserve)

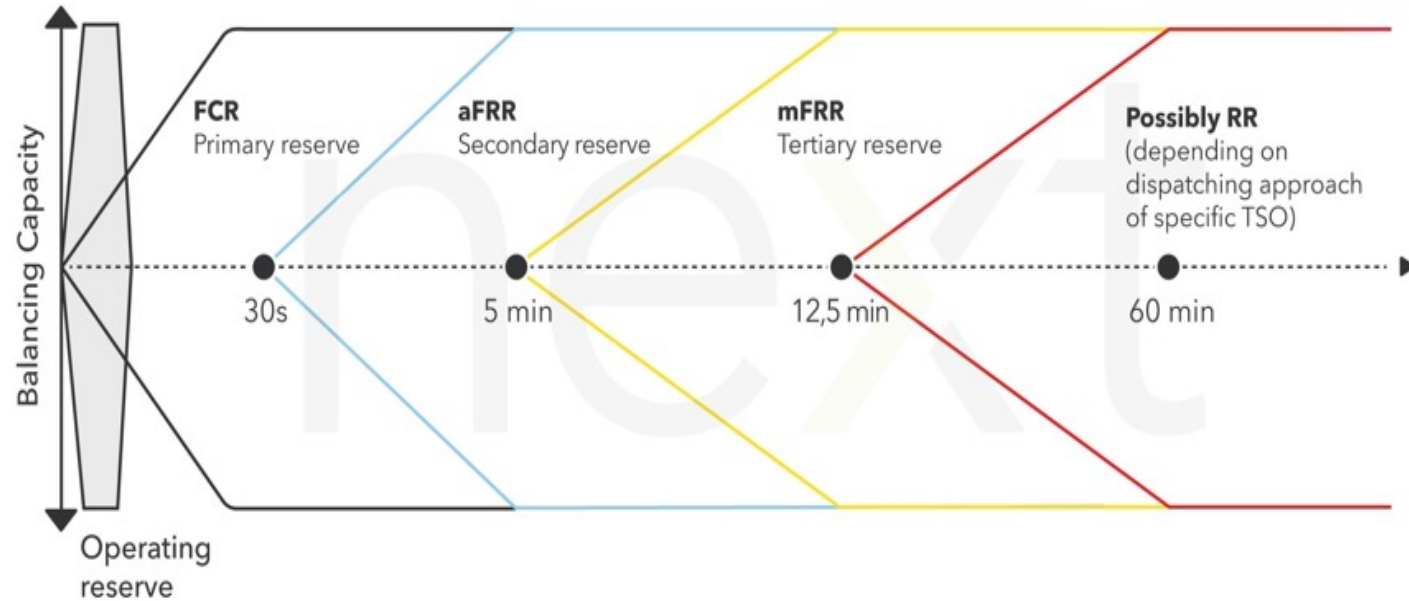
- Restores frequency to nominal value
- Full activation ~5 minutes
- Can operate until imbalance is corrected
- Automatic via TSO signal
- Part of the capacity/energy market



## Types of Ancillary Services

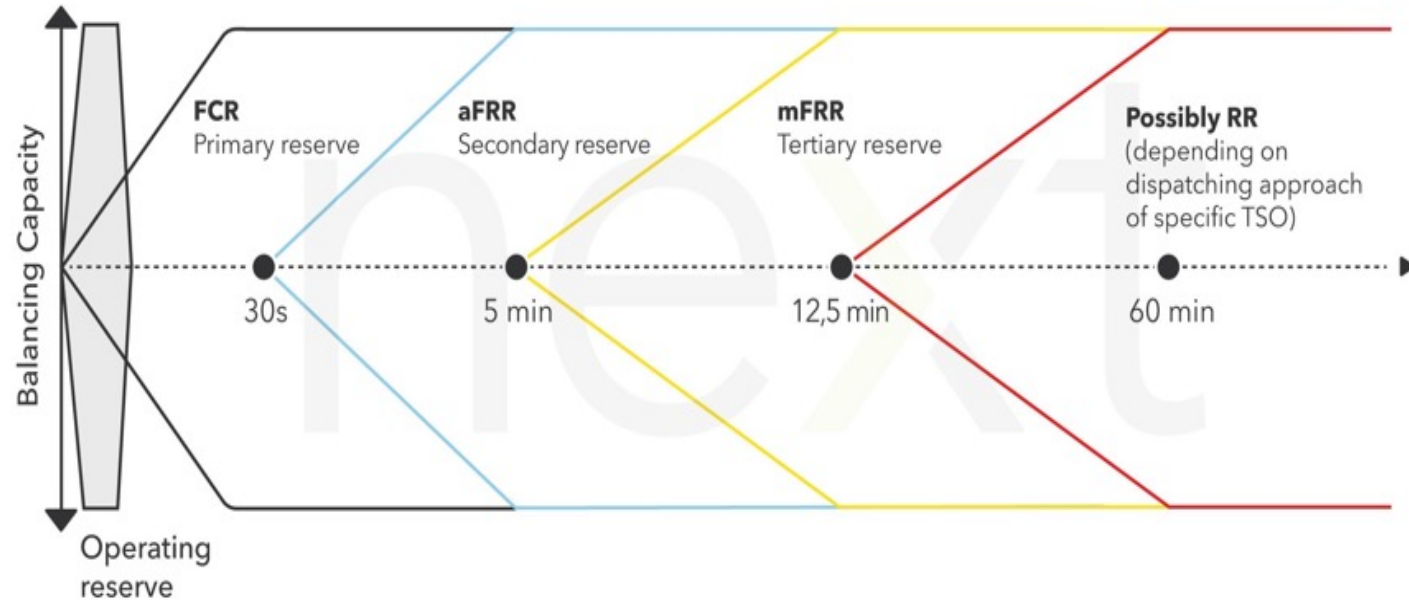
# mFRR (Manual Frequency Restoration Reserve)

- Replaces secondary reserve (aFRR)
- Full activation ~12-15 minutes
- Can operate continuously as needed
- Automatic via TSO manual dispatch
- Part of the capacity/energy market



## RR (Replacement Reserve)

- Replaces FRR reserves
- Full activation ~15-30 minutes
- Operated for longer periods
- Automatic via TSO manual dispatch
- Part of the energy market or separate contract



# 3. BESS for Ancillary Services

## Voltage control & Reactive Power

**BESS cannot  
compete  
with:**

Capacitor Banks



STATCOMs





BESS for Ancillary Services

Black start capability

Low short circuit current

Less cost effective

Less reliable, limited energy



## Operating reserves

### Limited energy availability

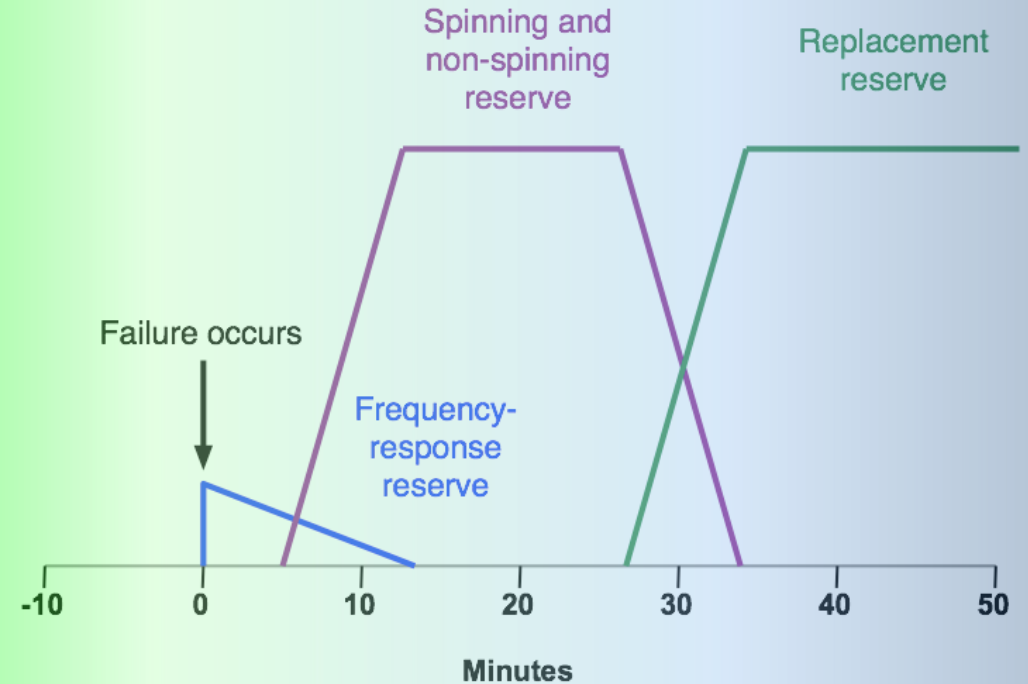
1, 2, 4 hours of operation

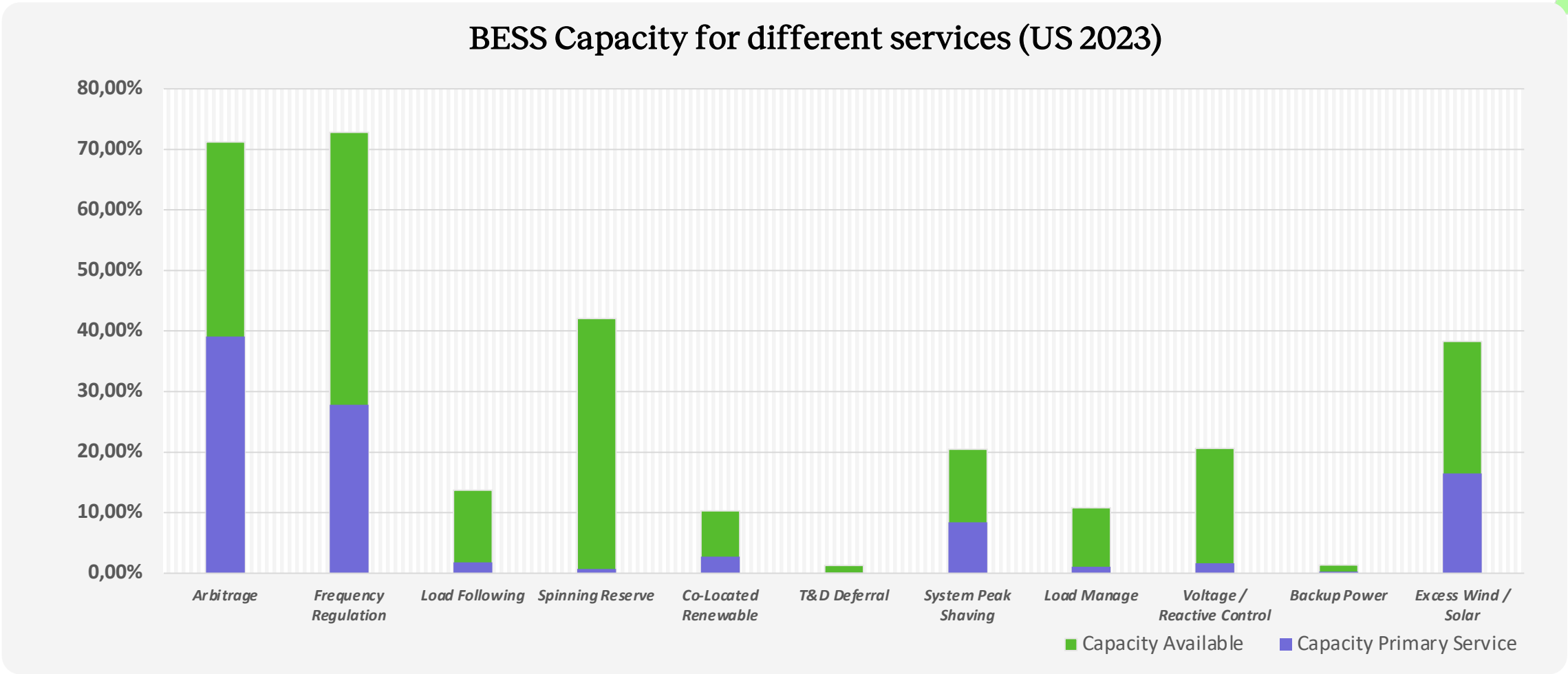
### Less cost effective

More expensive

### Opportunity cost

Other markets might be more lucrative

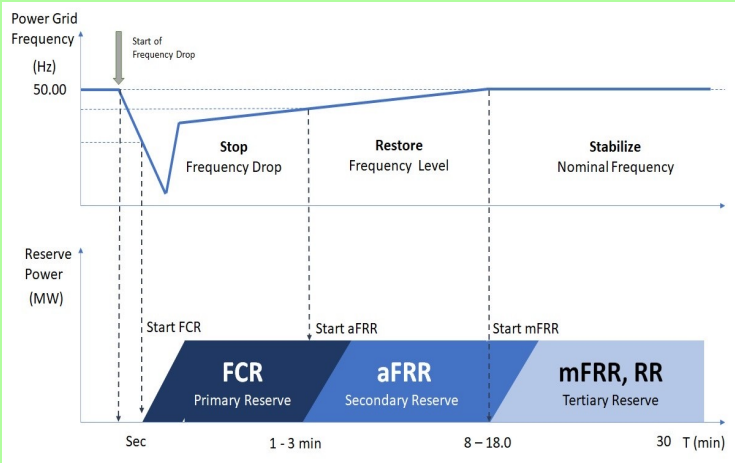




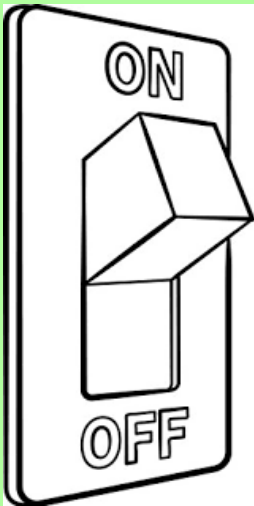
Source: US Energy Information Administration

# 4. BESS for Frequency Regulation

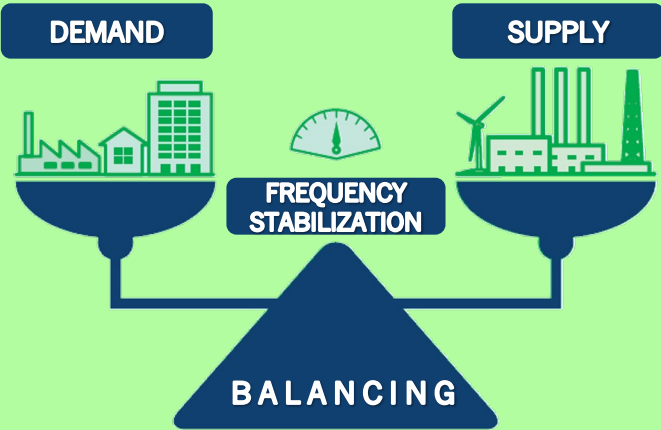
# Fast Response (seconds)



# Ramps up almost instantly

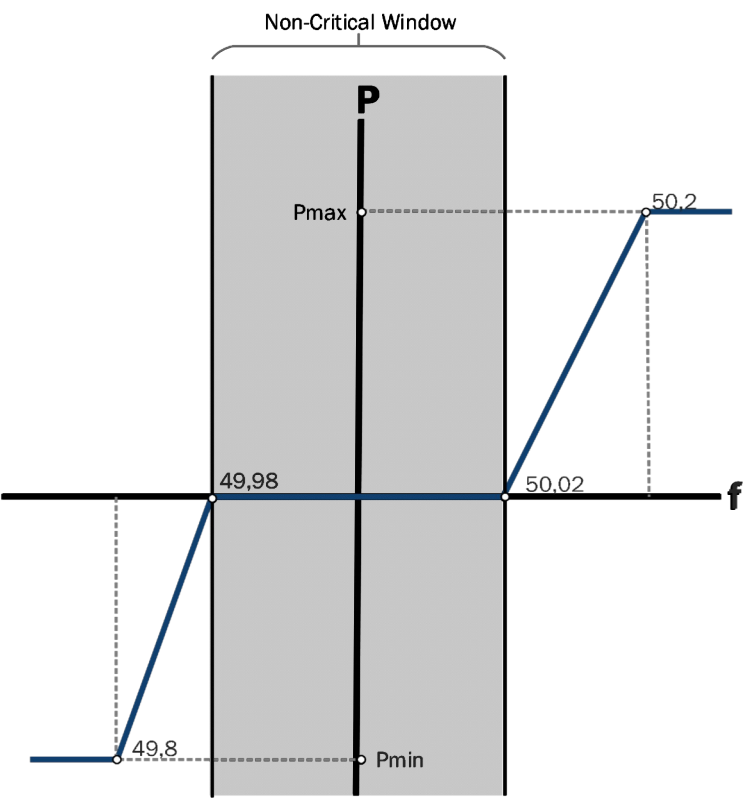


# Can balance supply and demand

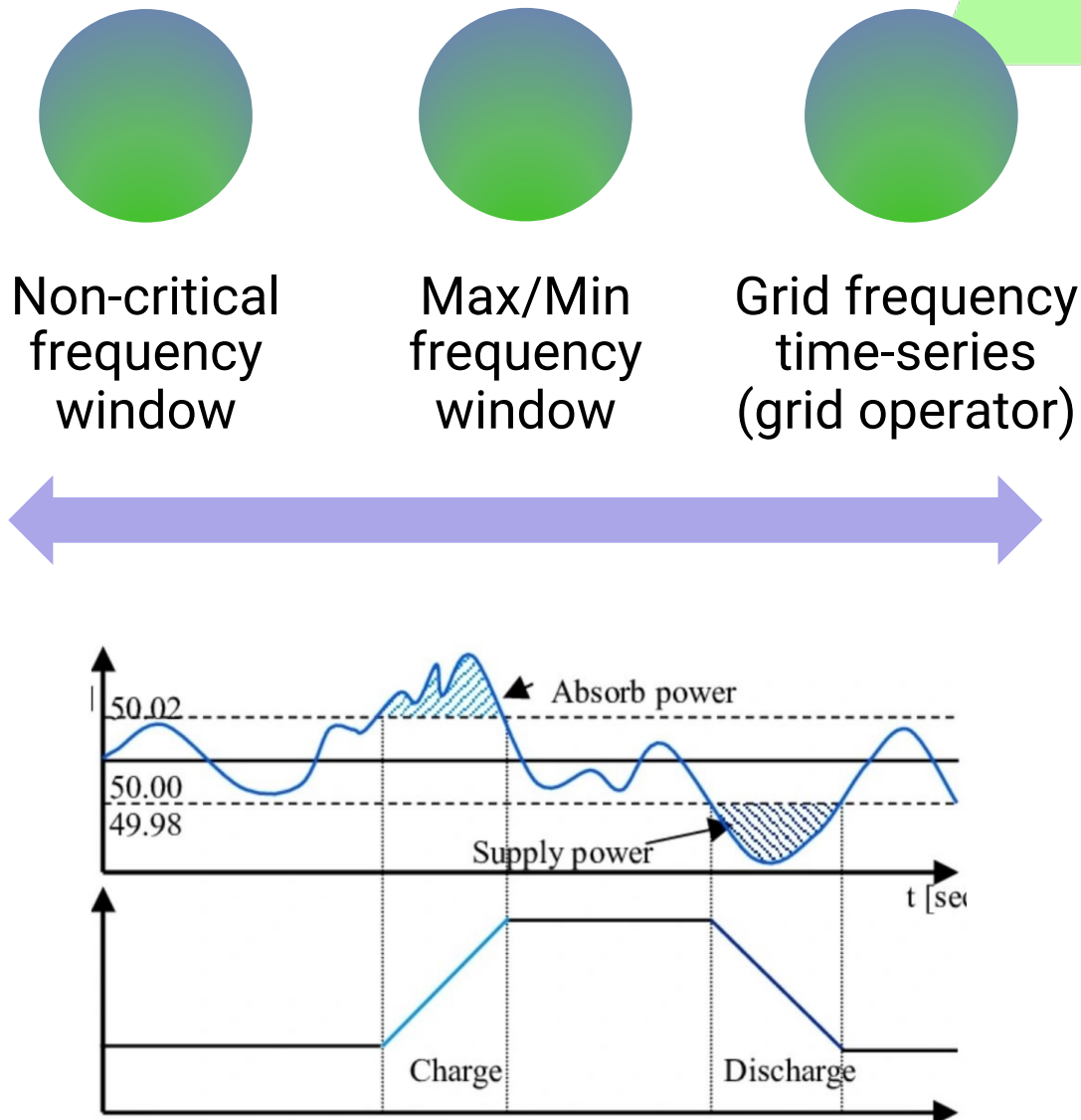


# Sizing of BESS for frequency regulation

## Frequency Droop Control



Source: ENTSOE (operation limits)

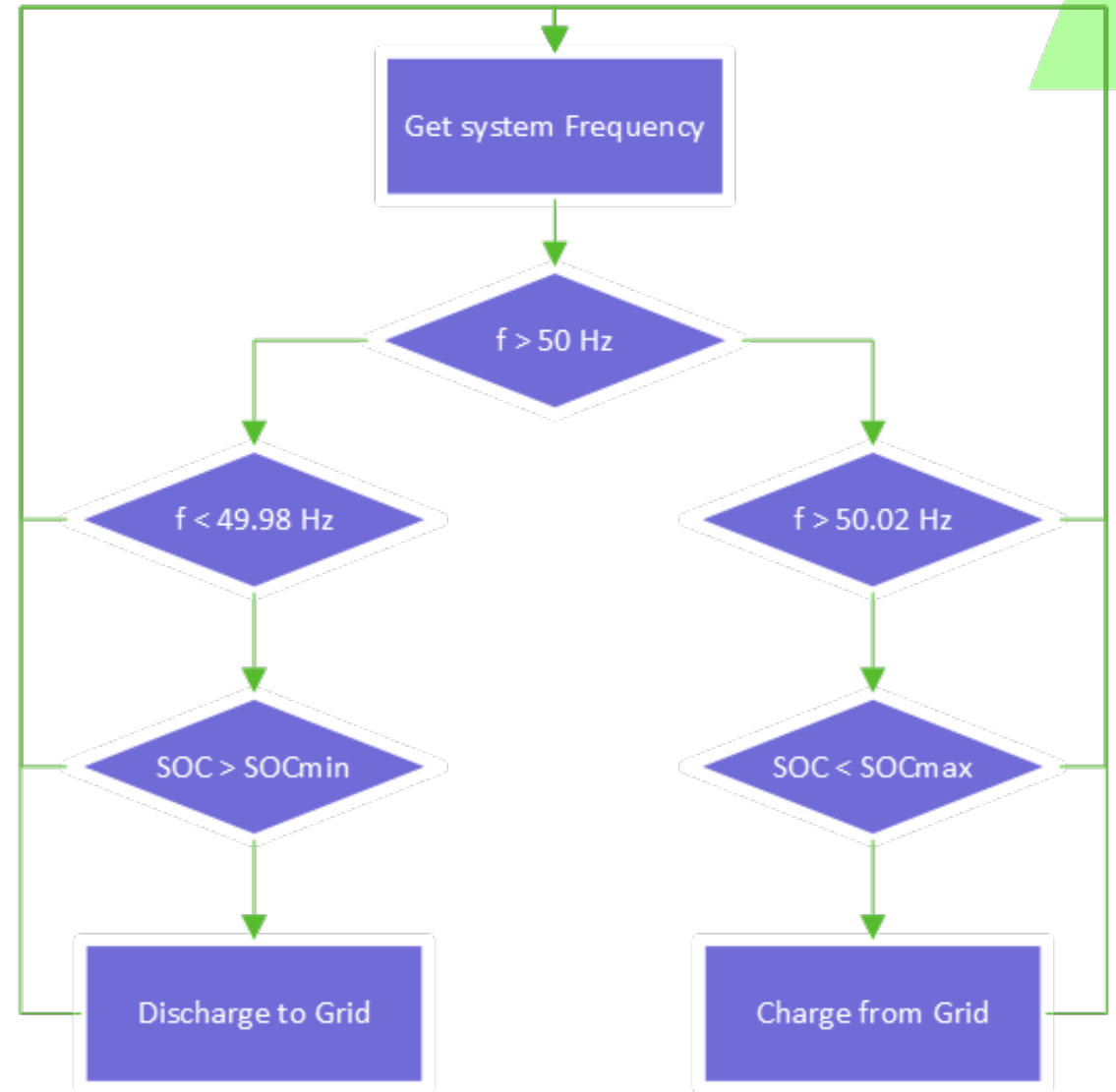


## Sizing of BESS for frequency regulation

Simulations with different installed Power/Capacity with a frequency time series

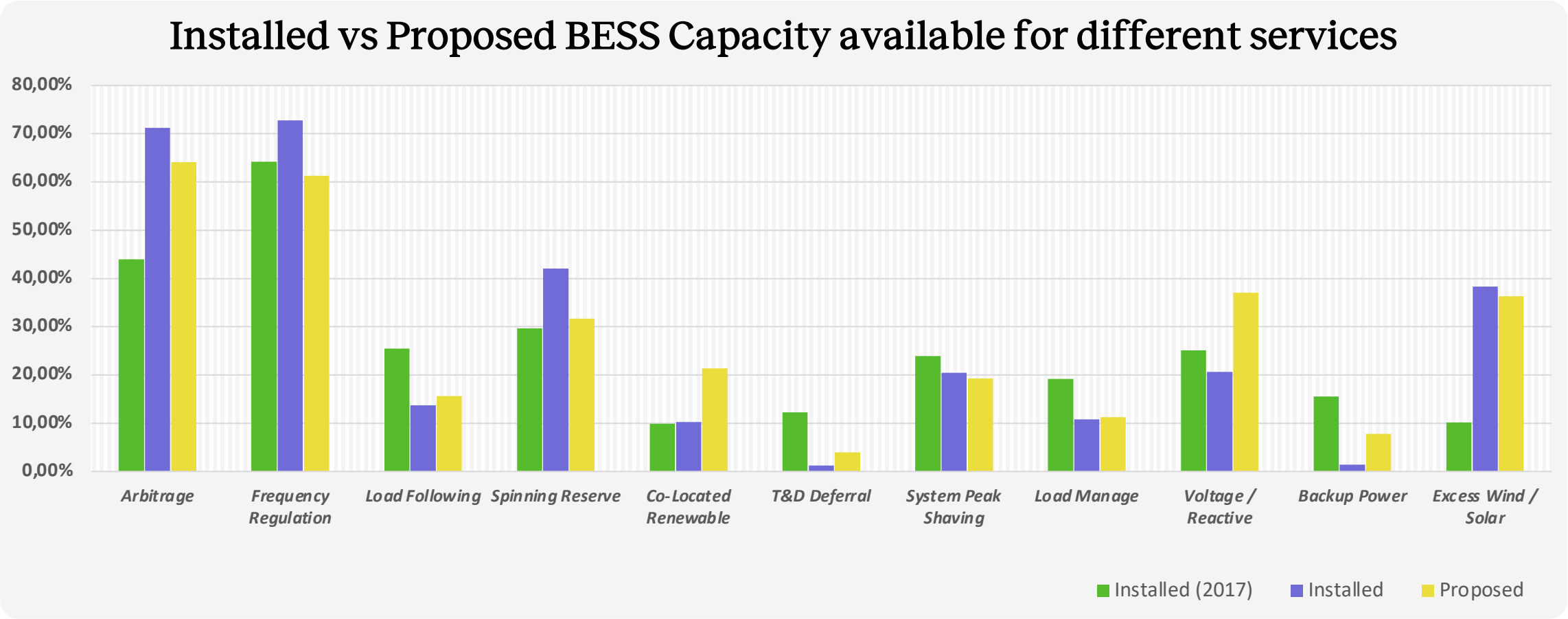
Include:

- Complex model (RTE, conversion losses, degradation)
- Economic variables (CAPEX, OPEX, revenue, etc)
- Combine other services (arbitrage, peak-shaving, etc)

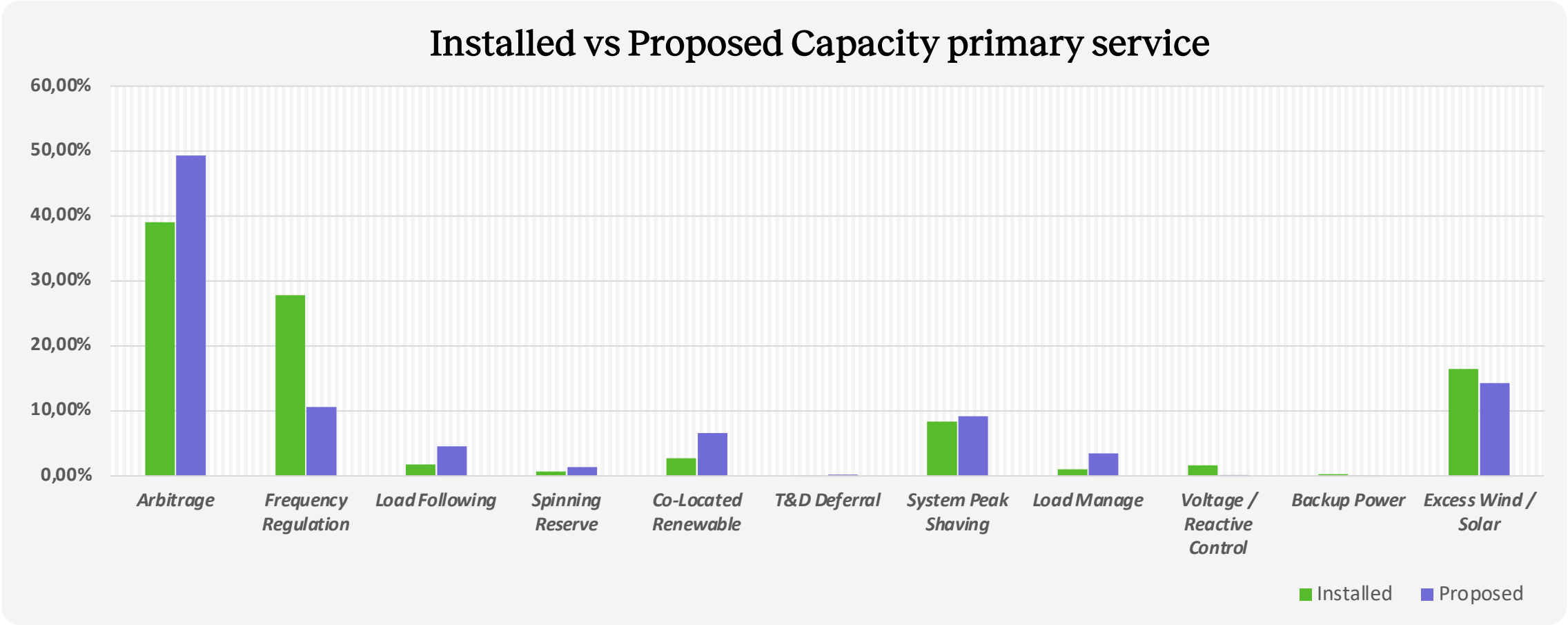




# 5. Future trends



Source: US Energy Information Administration



Source: US Energy Information Administration

Future trends

## Challenges

- Increasing renewable penetration
- Market saturation of Ancillary Services
- Shift towards mixed strategies
- Regulatory barriers



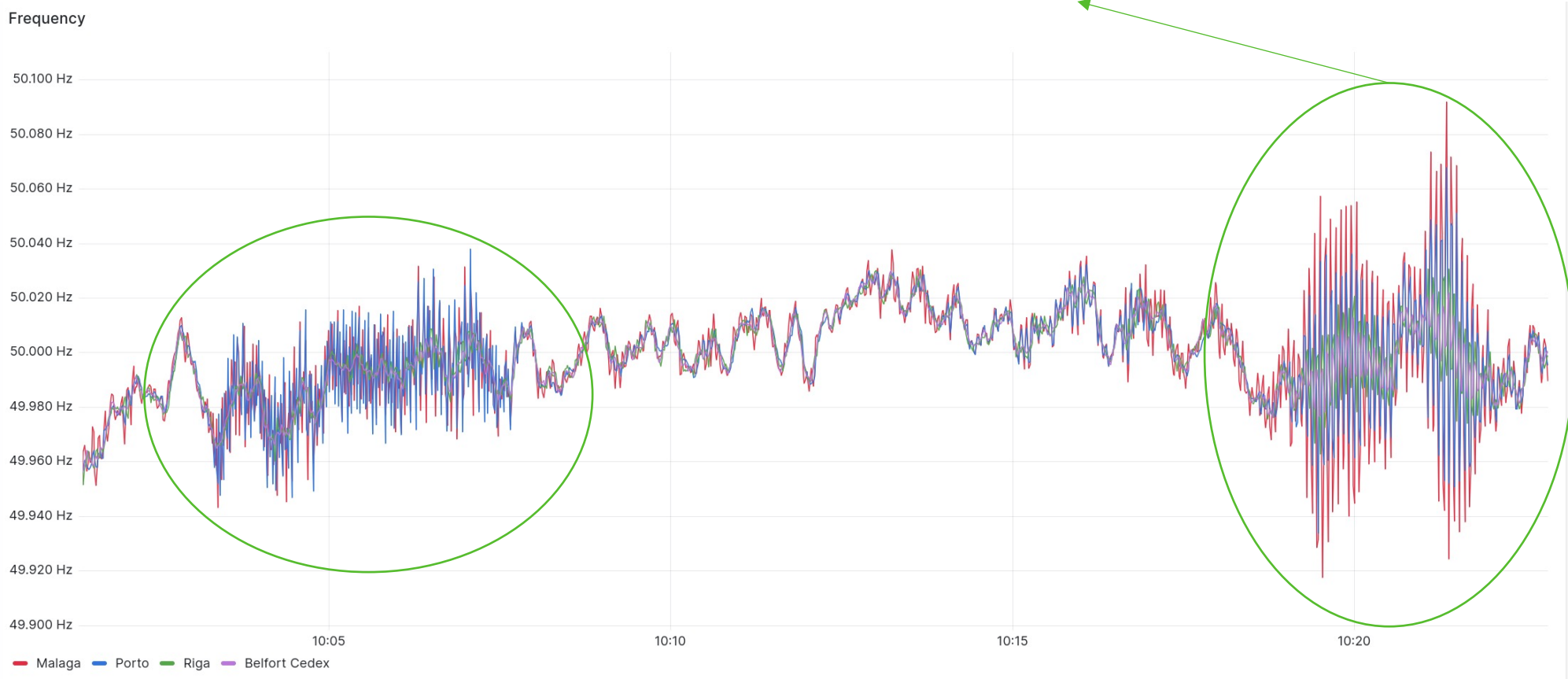
# 6. BESS in Iberia Blackout

# *Disclaimer*

*This is a hot topic, and there are still a lot of unknowns*

Iberia's blackout

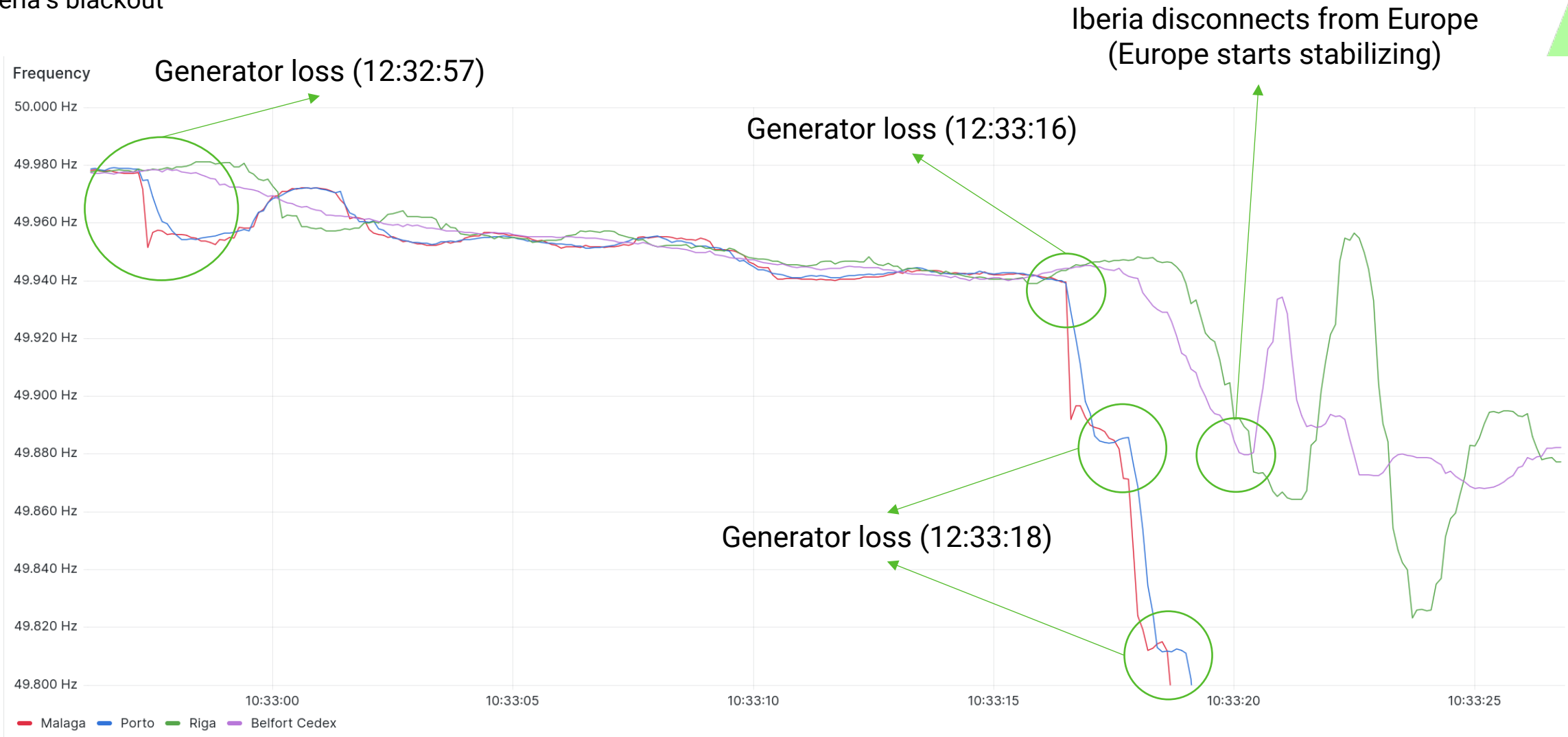
Interregional oscillations ~12:20  
(10-15 minutes before blackout)



Source: *Gridradar*



Iberia's blackout



Source: Gridradar

## BESS in Blackout

- Would BESS have helped during the blackout?
  - Probably!
- Would they have been enough?
  - We don't know!
- We still don't know what caused the generator loss
  - Could be RoCoF protection tripping
  - Could be phase angle difference
  - Could be caused by overvoltages



# Questions?

We're all ears!

Drop yours in the question box



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