Trading Batteries on Reserve and Spot Electricity Markets

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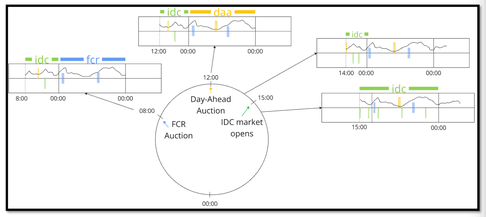
Introduction



Methods

1. Find optimal FCR trades given DAA and FCR prices
2. Then perform DAA and IDC optimization given past trades and simplified FCR model (Power 0, SOC 0.5)

- Perfect forecasts for prices, all bids are accepted
- Rolling Window approach allows for virtual trading
- Solved with GLPK & Pyomo
- Hourly simulation of one year on i5-124U (1.6 GHz, 10 cores, 16GB RAM) in 10 minutes

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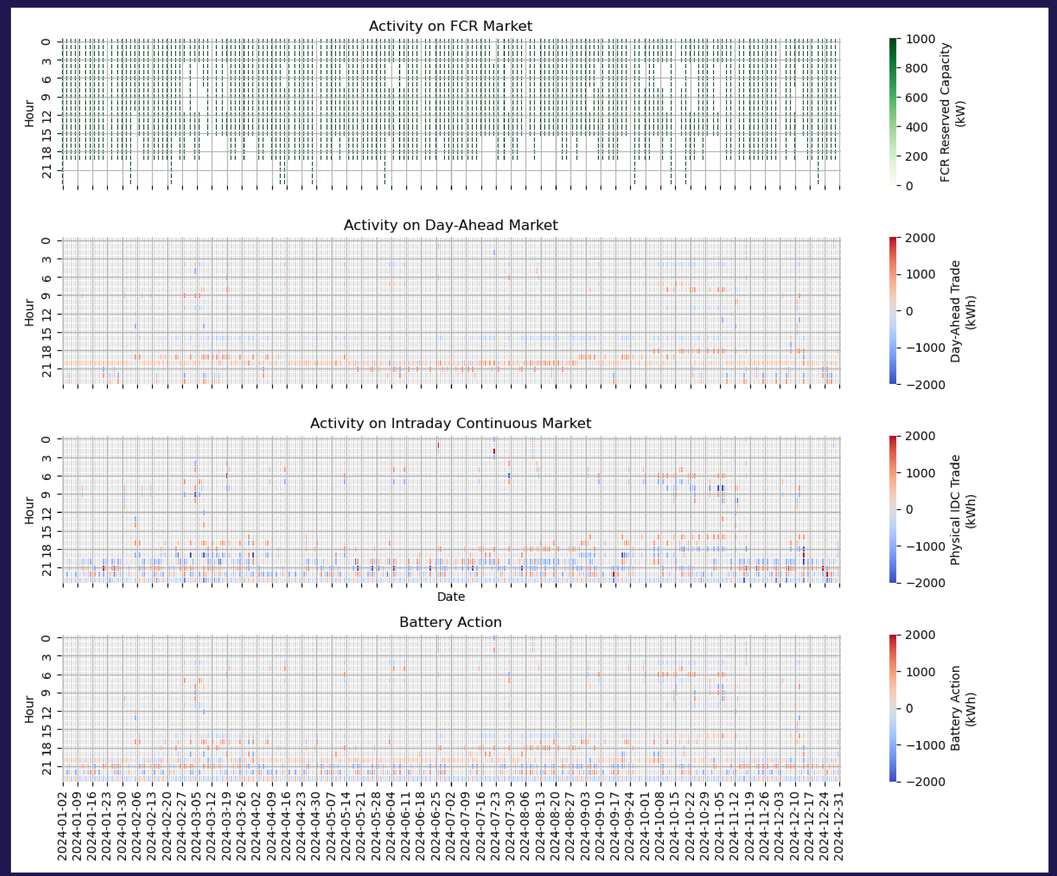
Batteries that switch between **stabilizing the grid** and **energy trading** show distinct **daily and seasonal patterns**



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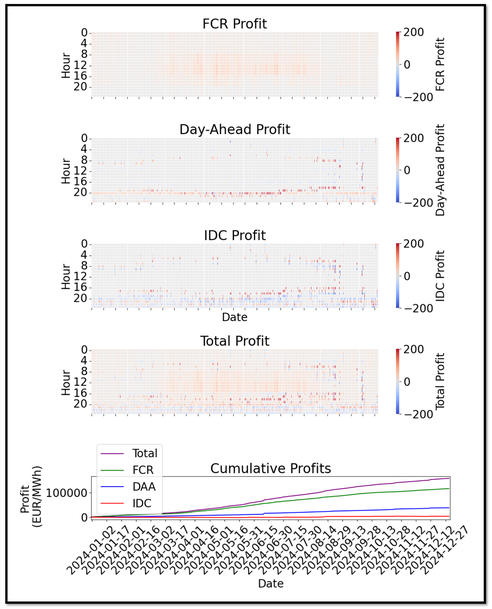
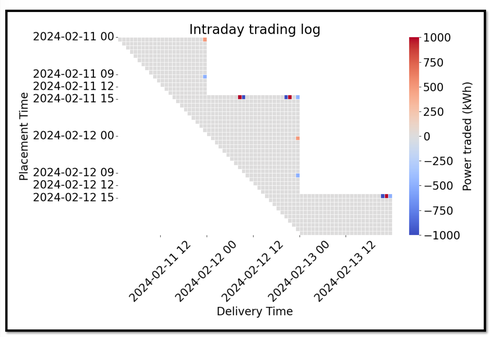
Results



- 74% of profits from FCR, 24% from Day-Ahead, 2% from Intraday market
- FCR activation mostly at night and midday
- Spot market trading in early morning and late evening
- Very little virtual trading



$$\underset{\sigma, B, P, P_c, P_d, \alpha}{\text{maximize}} \quad \sum_{i \in T} \pi_i * B_i * \Delta t \tag{1a}$$

$$\text{subject to} \quad \sigma_{i+1} = \sigma_i - \Delta t * \left(\frac{P_{d,i}}{\eta_d * C}\right) - \frac{P_{c,i} * \eta_c}{C}, \tag{1b}$$

$$P_i = P_{d,i} + P_{c,i}, \tag{1c}$$

$$P_{c,i} \geq \alpha_i * \overline{P_c}, \tag{1d}$$

$$P_{d,i} \leq \alpha_i * \overline{P_d}, \tag{1e}$$

$$P_i = B_i + S_i, \tag{1f}$$

$$\sigma_0 = \sigma_{\text{init}}, \tag{1g}$$

$$P_i = 0 \quad \text{if FCR active,} \tag{1h}$$

$$\sigma_i = 0.5 \quad \text{if FCR active,} \tag{1i}$$

$$\sigma_{T_\sigma} = 0.5 \quad \text{if FCR is active directly after horizon} \tag{1j}$$