All-in-One Battery Optimization: AI-Supported Fully Autonomous Analytics, Trading, and Connectivity

Önder Akar
oakar@smartpulse.io

4 December 2024, Italy

smartPulse

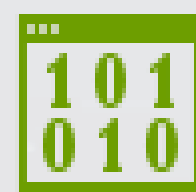# The Only All-in-One Platform Targeting the Widest Market Coverage Across Europe

All-in-One Solution
Combines trading and battery optimization under one system

European Presence
Active in all major energy markets

Algo-Trading
The most trader-friendly algo trading suit with the broadest market coverage

Proven Expertise
Managed >20 TWh of algo-trades in the last 12 months

smartPulse

We are Not an Optimizer
We Empower Optimizers with Cutting-Edge Technology

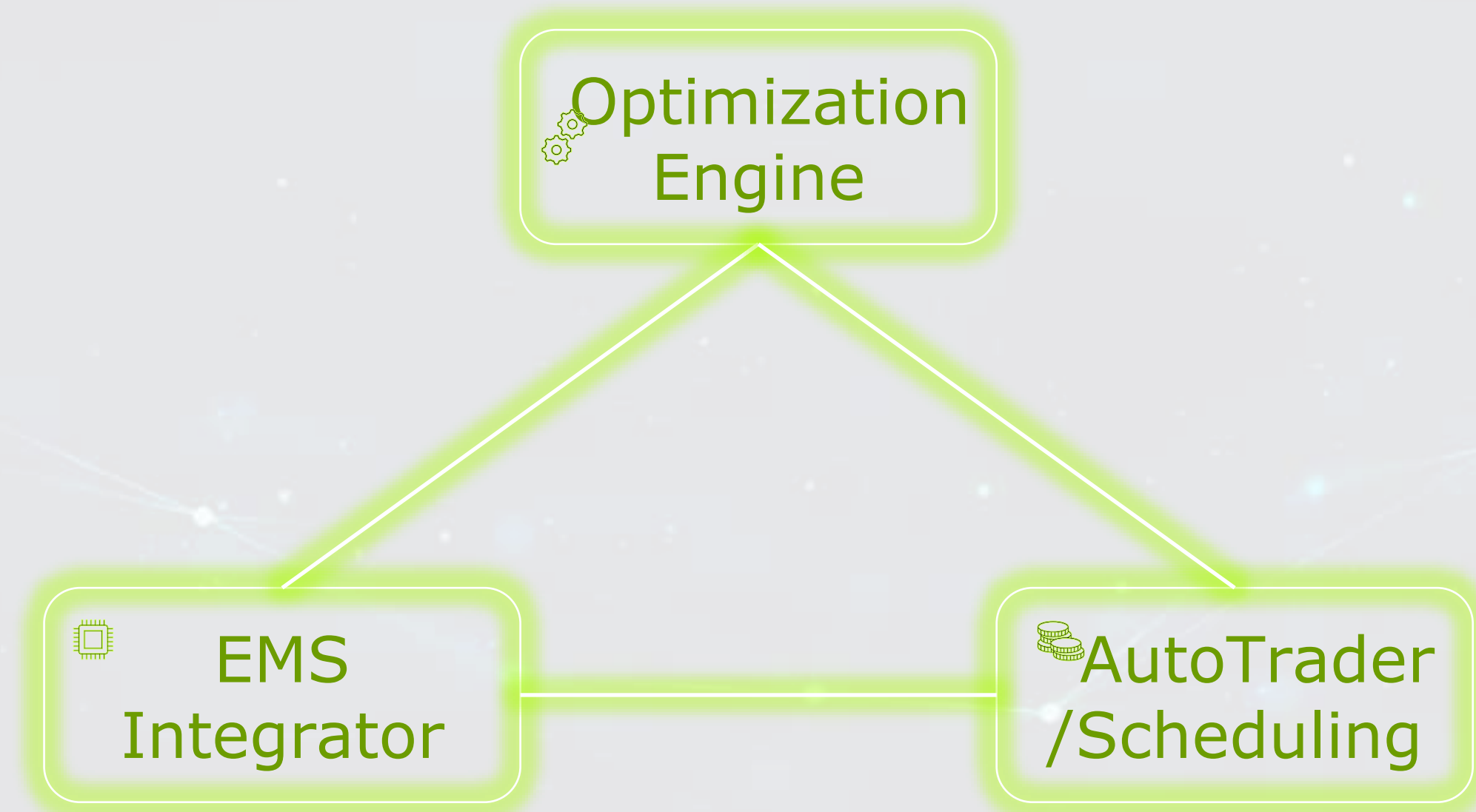Technologies for
- Optimizers
- Aggregators
- Route-to-market providers

to manage **batteries and short-term trading** effectively

Optimization Engine

EMS Integrator

AutoTrader /Scheduling

smartPulse
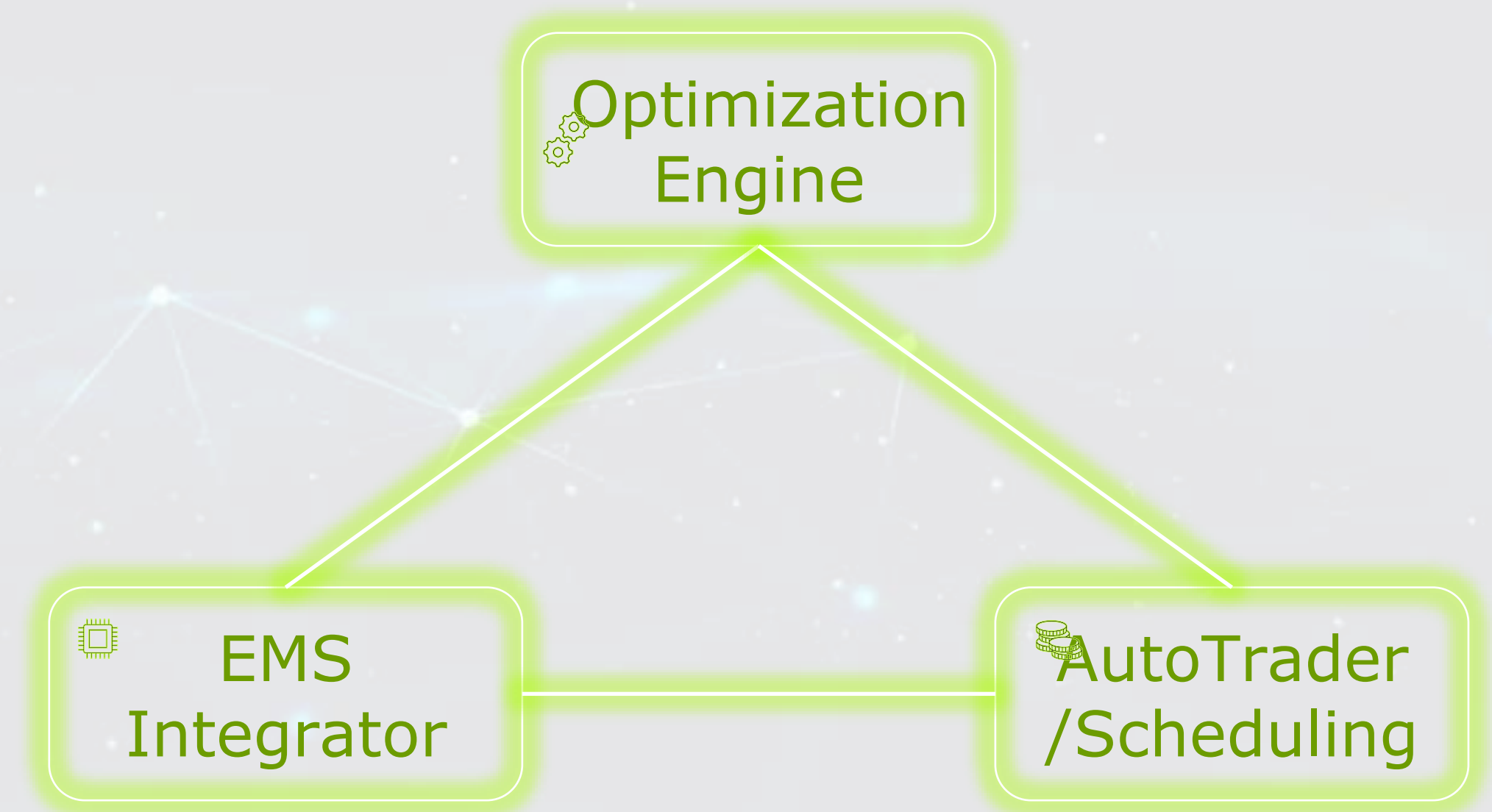
The Daily Operation of Battery Assets Requires
Three Components to Work in Harmony

Optimization Engine

EMS Integrator

AutoTrader /Scheduling

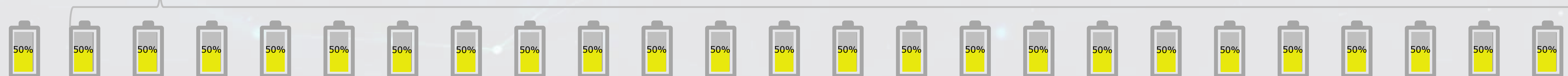So, How does this **harmony** work exactly?

And what are the **key points** to consider?

smartPulse

A simple example : Focus on only intraday trading
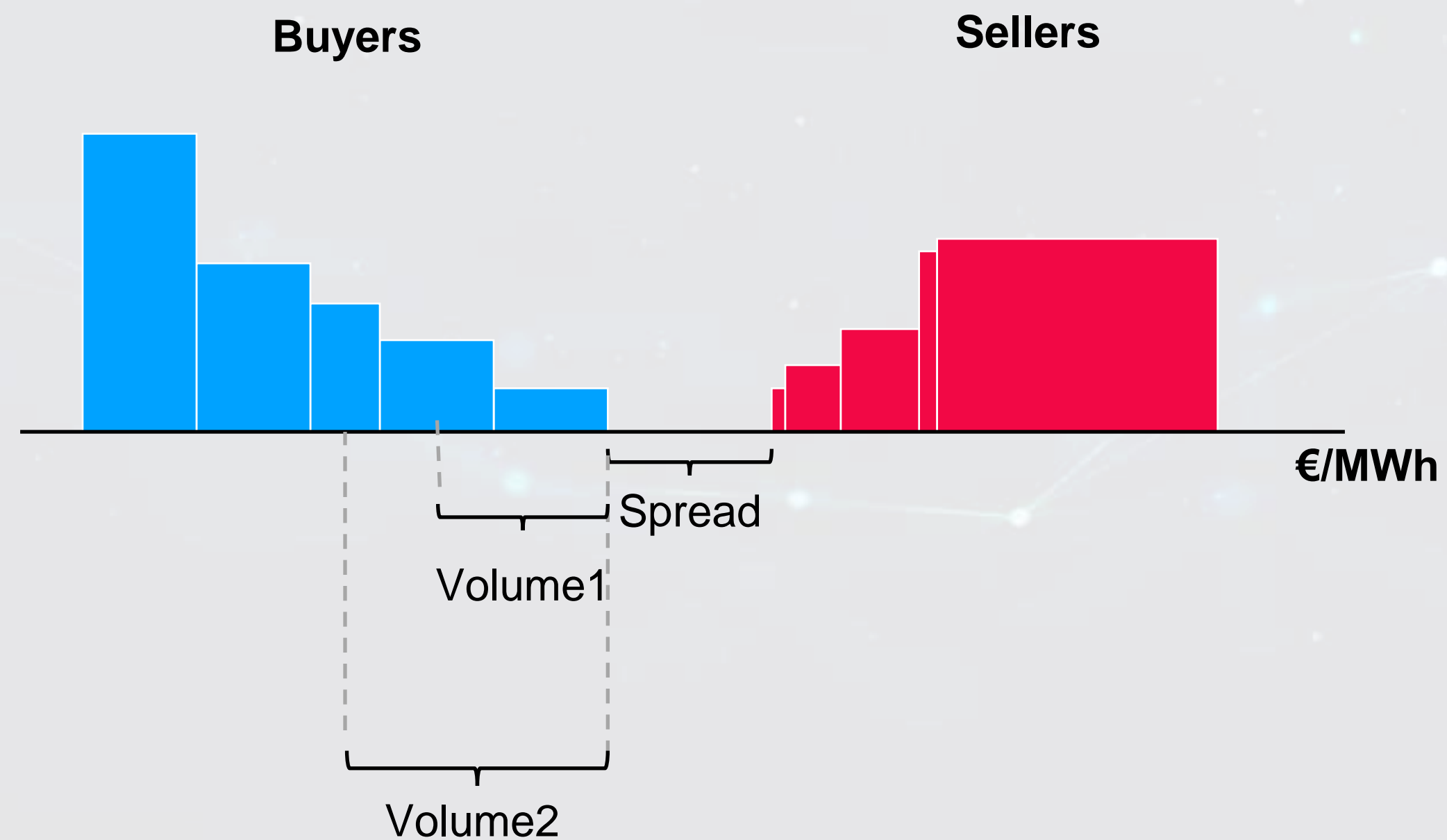
10MW, 10MWh Battery

Planned SoC

Initial state

in the continuous intraday market, **orderbook changes constantly**.

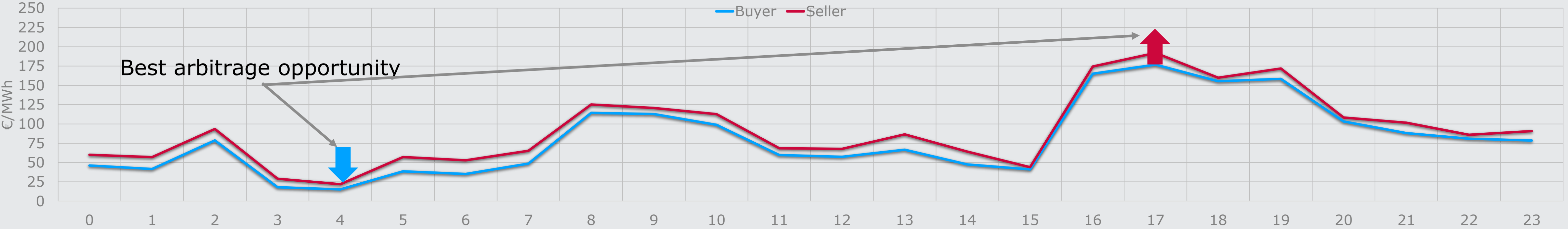**fast optimization** is essential for finding the best buy-sell combinations for arbitrage

smartPulse

Another complication : Buyer / Seller price depends on orderbook depth

Buyers

Sellers

€/MWh

Spread

Volume1

Volume2

Price for Volume 1 > Price for Volume 2

smartPulse

A simple example : Focus on only intraday trading , Arbitrage

10MW, 10MWh Battery

Best arbitrage opportunity

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
SoC Plan	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Buy					4MWh 22€																			
Sell																		4MWh 177€						
Energy Output*					-4 MWh													+4 MWh						
New SoC Plan	50%	50%	50%	50%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	50%	50%	50%	50%	50%	50%	50%

Margin
155€/MWh x 4MWh = 620€

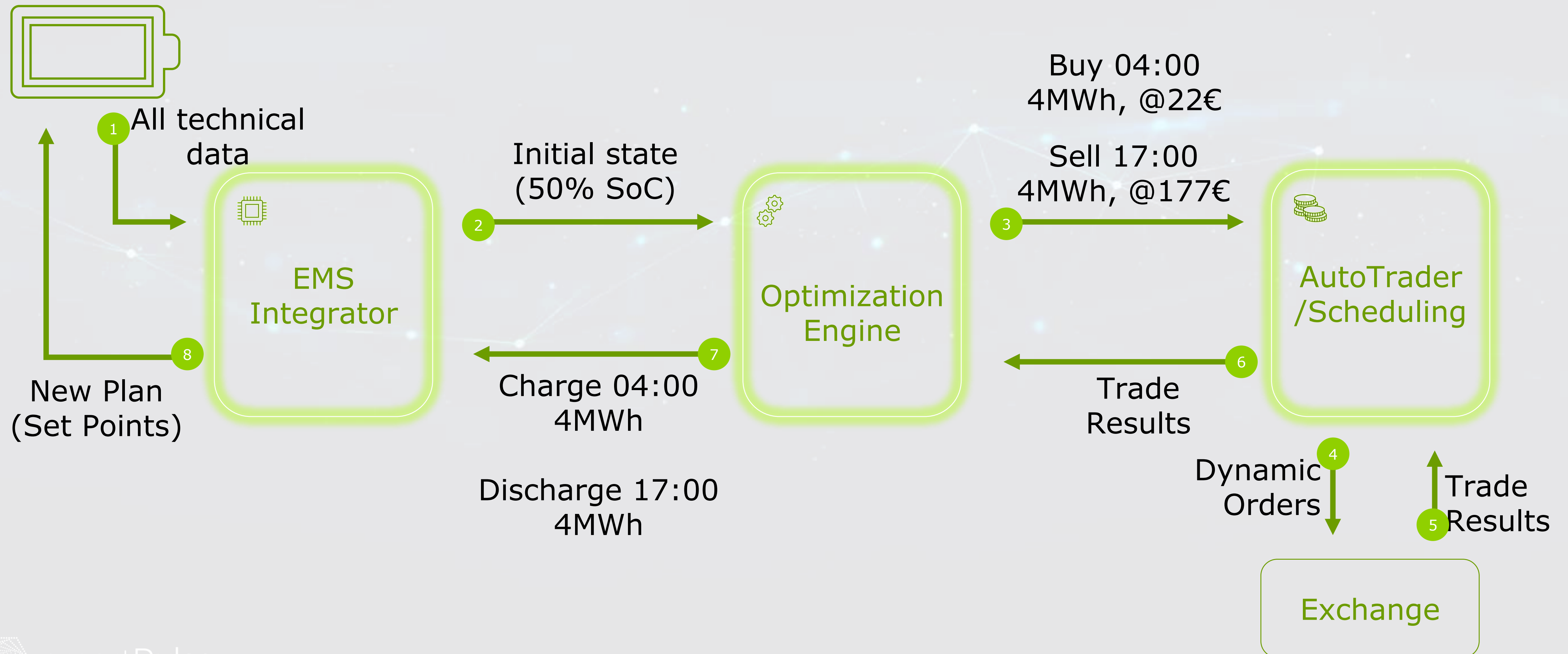**Discharged Energy**
4MWh

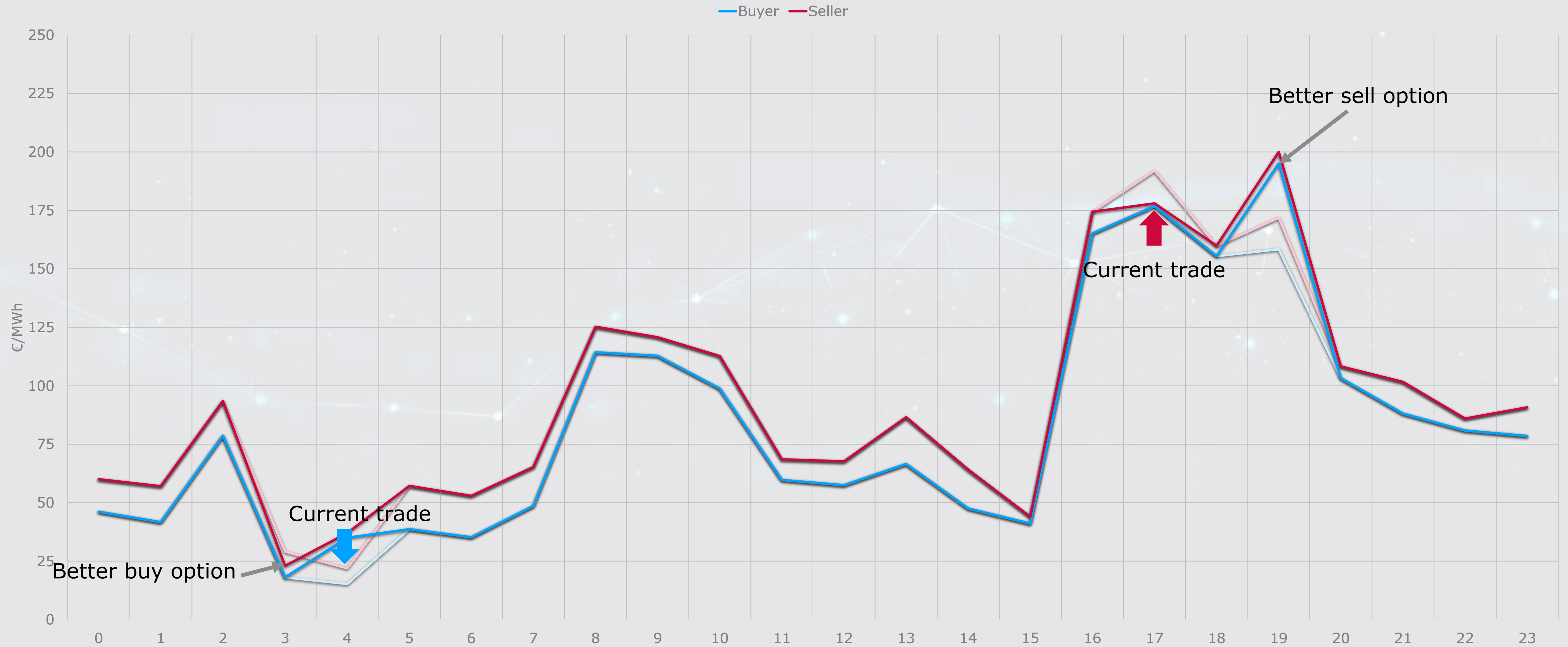**Margin per unit of Discharged Energy**
155€/MWh

* : Efficiency is considered 100% for sake of simplicity

smartPulse

In the background : Optimization Cycle

The operation requires the EMS integrator, optimization engine, and algo-trader to function in perfect synchronization. This collaborative process is what we call an **optimization cycle**.
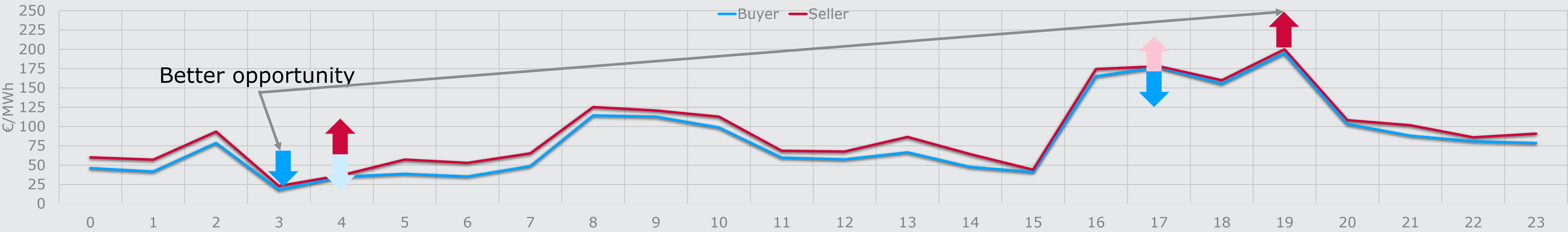
All technical data ①

EMS Integrator

Initial state (50% SoC) ②

Optimization Engine

Buy 04:00 4MWh, @22€

Sell 17:00 4MWh, @177€ ③

AutoTrader /Scheduling

New Plan (Set Points) ⑧

Charge 04:00 4MWh ⑦

Discharge 17:00 4MWh

Trade Results ⑥

Dynamic Orders ④

Trade Results ⑤

Exchange

smartPulse

Fluctuations in market prices can unlock new opportunities

Arbitrage Shift

10MW, 10MWh Battery

Better opportunity

SoC Plan	50%	50%	50%	50%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	50%	50%	50%	50%	50%	50%	50%
Buy				4MWh 23€	4MWh 22€													4MWh 178€						
Sell					4MWh 35€													4MWh 177€	4MWh 195€					
Energy Output				-4 MWh	-4 MWh													+4 MWh	+4 MWh					
New SoC Plan	50%	50%	50%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	50%	50%	50%	50%	50%	50%

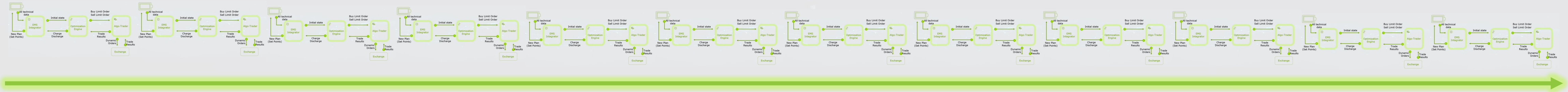| **Margin**	**Discharged Energy**	**Margin per unit of Discharged Energy**	
735.49	4MWh	**184€/MWh**	**Same discharge, higher margin**

The optimization cycle needs to run at regular intervals

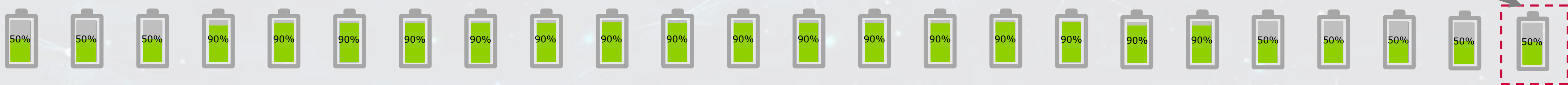However, **longer intervals may lead to missed opportunities**
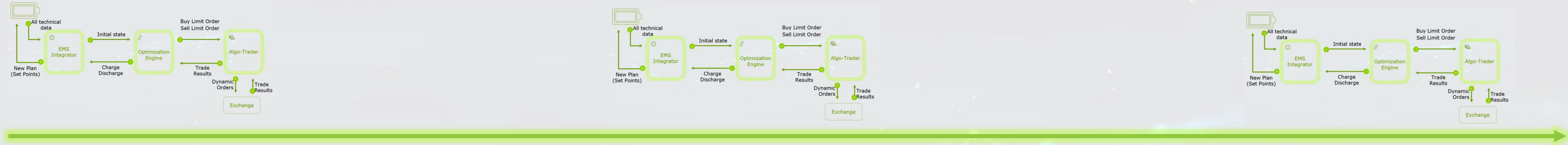
Therefore, **seamless integration** between components is essential for optimal performance.

smartPulse

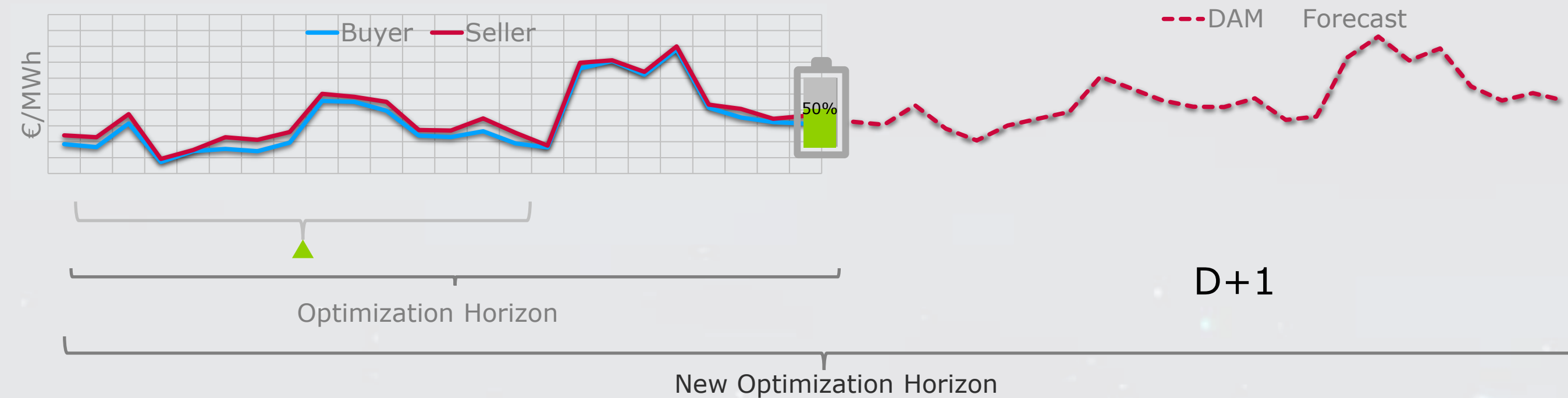# What's the Value of Energy Left at End of the Horizon?

How to decide whether to fully charge, fully discharge, or end at the initial level?

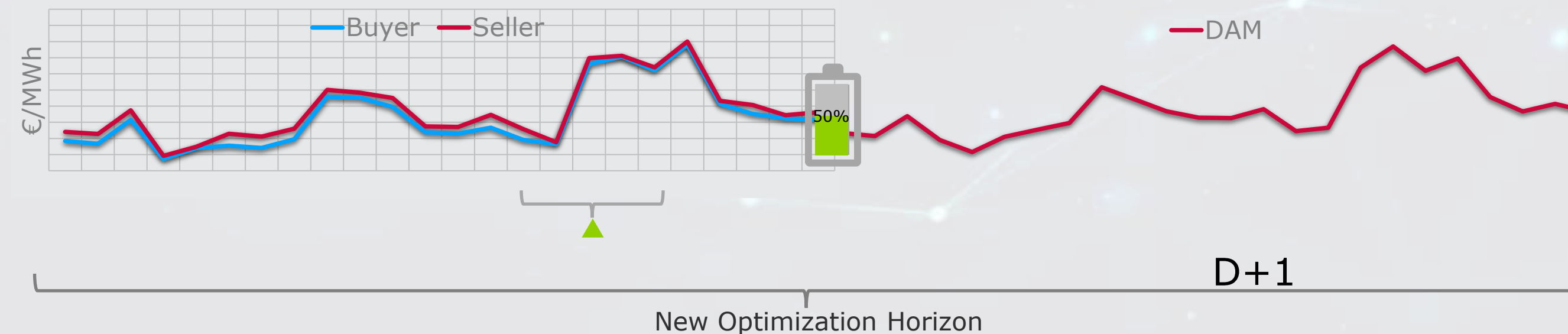the energy remaining in the battery has a value,
potential for future use

Valuing Remaining Energy: Using a Shadow Run Approach

## Phase 1 :DAM and IDM contracts for the next day are not yet available

The optimization performs a **shadow run** by considering **future opportunities**.

Phase 2 :DAM Prices available but IDM contracts for the next day are not yet available

Thus, the end-of-day **SoC target** for Day D becomes a decision point within a longer-term optimization model.
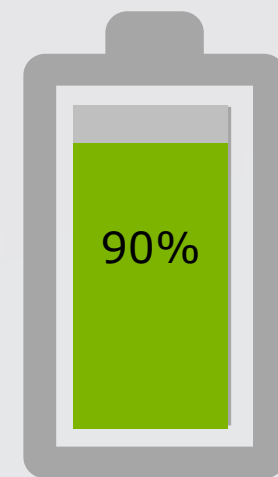
Phase 3 :IDM contracts are available
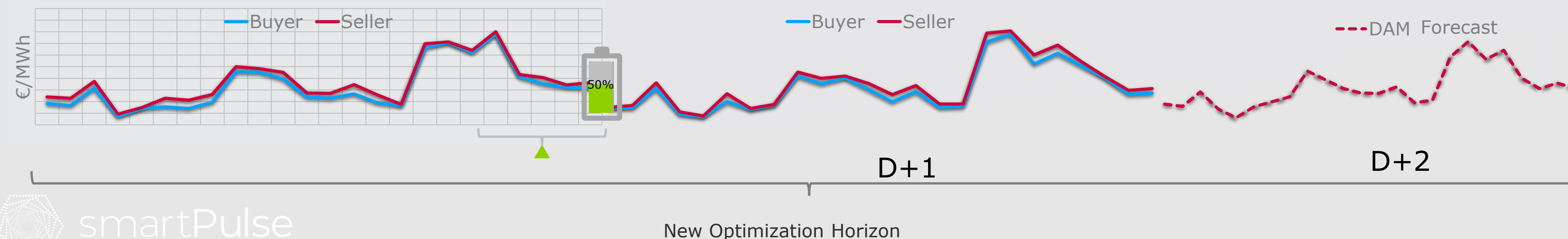
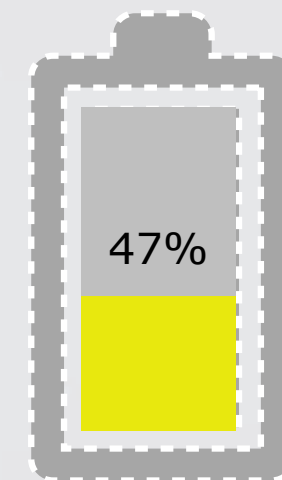This serves **as a target** for the actual optimization process.
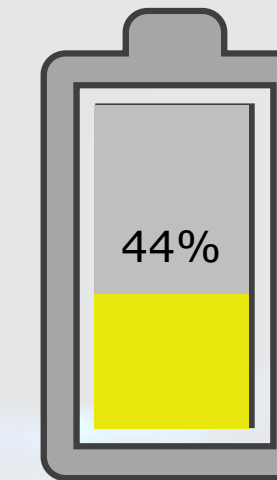
smartPulse

Efficiency Gaps: the Theory and Reality

Inputs

90%

Max   : 9MWh
Min   : 1MWh
SoC   : 9MWh
SoC   : 90%
Efficiency : 92%

Optimization Output

47%

Output   : 4MWh
Target SoC : $9 - (4 / 0.92) = $ **4.65MWh**

Real EMS Data

44%

Output : 4MWh
SoC   : 4.45MWh
Actual Efficiency : 88%

Problem:

Difference between theoretical efficiency (92%) and actual efficiency (88%) creates a SoC imbalance for subsequent optimization cycles

Solution:

• Real-time tracking of actual battery efficiency

• Updating optimization models with the realized efficiency values.

smartPulse

What We've Discussed Is Just an Example— Real-World Scenarios Are Far More Complex
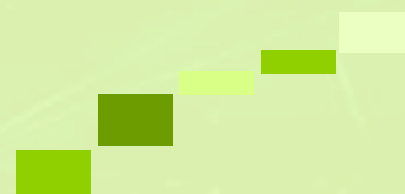
Complex Intraday Products

15-minute, 30-minute, and hourly contracts require cross-product trading to maximize profits.
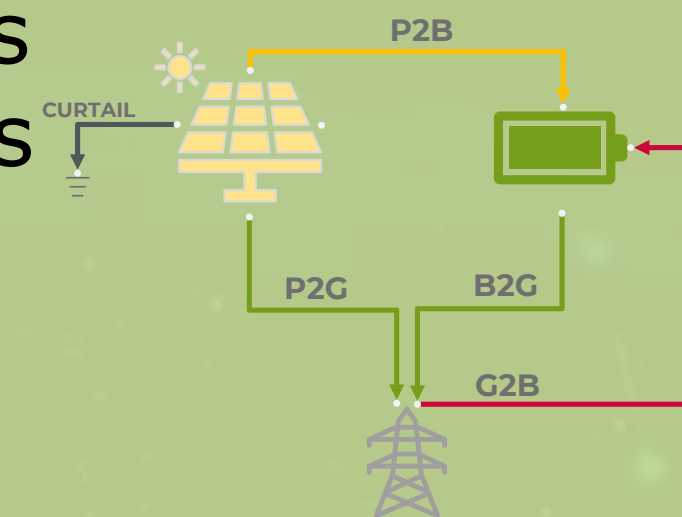

Multimarket Optimization

- DAM,IDA,Ancillary Services and IDC
- Continuously updating bids while **considering opportunity costs**
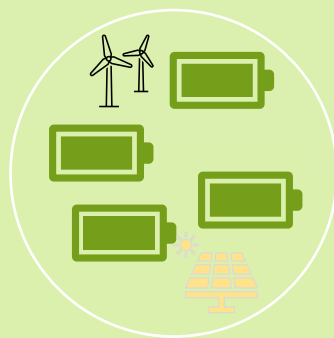- Evaluating potential opportunity costs for better decision-making

Co-Located Batteries

- Power plant forecasts
- Imbalance risks
- Grid constraints

Portfolio Optimization

Portfolio-Based Optimization for Multiple Assets Under One Trading Unit

Degradation Cost

- Battery lifespan varies with DoD levels
- Cycles are based on DoD levels specific to each market's characteristics
- Cost adjustments in optimization.

Trader Insight

- Traders' insights often surpass AI in specific scenarios
- Allowing traders to input expectations into the optimization model

smartPulse

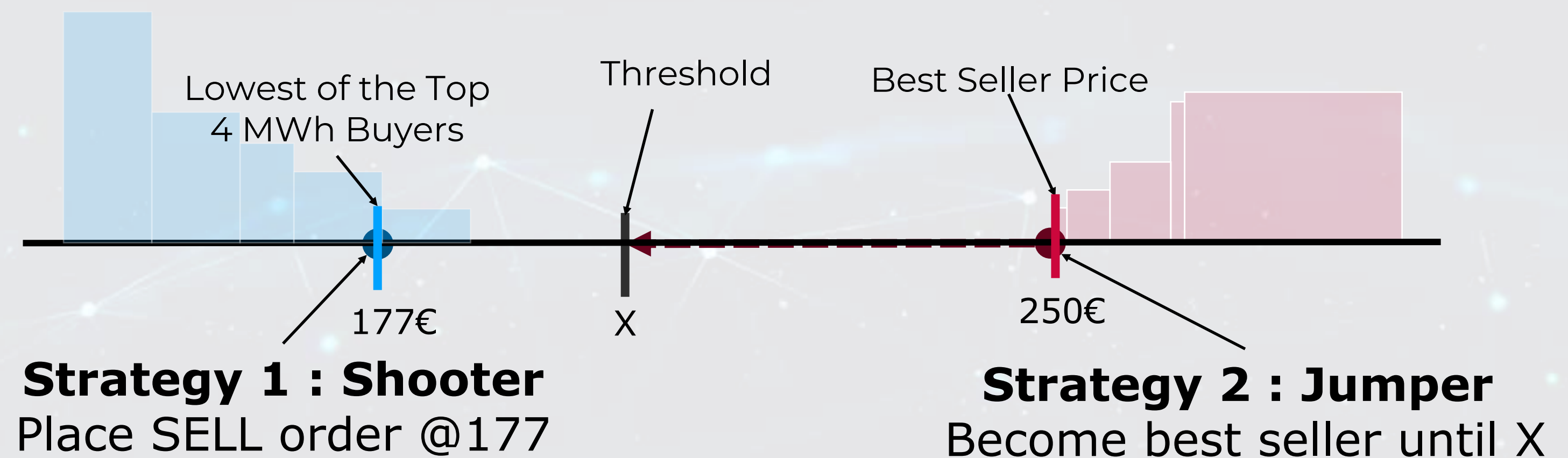# Risk Appetite-Based Behaviors: An Example of Trader Insight

Example : the Optimization Engine **decides to sell at €177**.
How will we submit this offer to the market using an appropriate strategy?

Traders Strategy

Order Book

If Seller > X Then
        Strategy = Jumper
Else
        Strategy = Shooter

Lowest of the Top
4 MWh Buyers

Threshold

Best Seller Price

177€

X

250€

Strategy 1 : Shooter
Place SELL order @177

Strategy 2 : Jumper
Become best seller until X

Sometimes, better value can be captured by being the best seller (or buyer) in the market instead of placing a limit order

on smartPulse trading platform, traders can easily formulate this and similar parameters

```
<> minPriceLimit  ⓘ

RTIME < 5 ? BESTBUYP : BESTBUYP + 25
```

smartPulse

Thank You

smartPulse

We **democratize the Optimizer world** by providing an end-to-end platform.

Instead of spending time on building software, focus on finance, operations, and trading while we provide the **complete technological infrastructure** for your success

www.smartpulse.io

gloal@smartpulse.io

smartPulse