



Large Scale Solar EU 2024

Navigating the Shift: Utility-Scale PV and Storage Hybridization

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SMA Solar Technology AG

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Agenda



- 1** Introduction
- 2 Motivation
- 3 Challenges
- 4 Solutions
- 5 Summary

SMA Solar Technology AG (2024)



SMA = “Energy transition company” and pioneer for decarbonization & decentralization since 1981:

> **130 GW** installed solar inverters

> **10 GW** installed battery inverters

> **86 MT/a** CO₂e avoided

> **1,700** patents & utility models

> **4,000+** employees

> **20** countries (sales & service)

Key financials 2023

| | | |
|----------------------|------------|-------------|
| Sales: | MEUR 1,904 | (+79% YoY) |
| EBITDA: | MEUR 311 | (+344% YoY) |
| Inverter power sold: | 20,5 GW | (+68% YoY) |

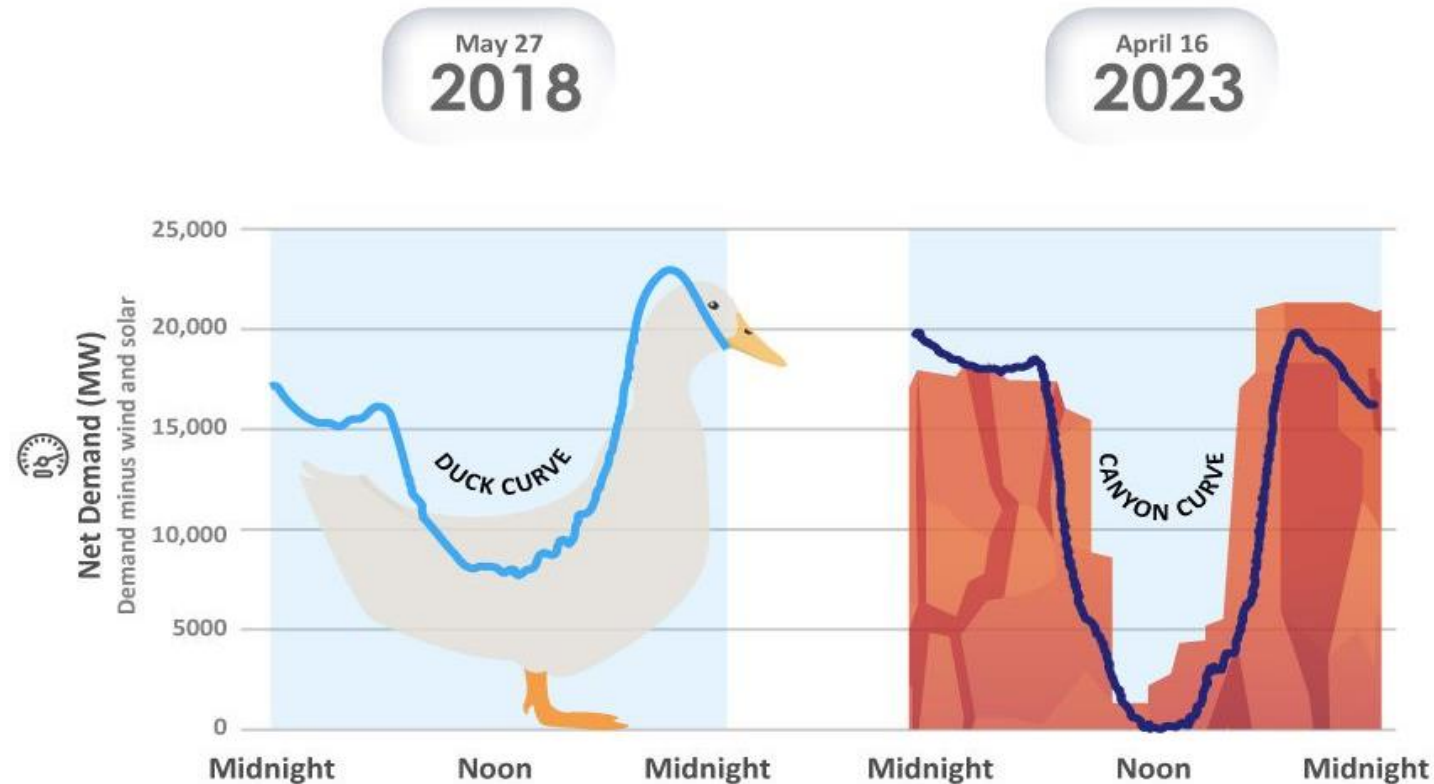
Second **SMA GIGAWATT-FACTORY** will almost double today's production capacity at HQ in Germany to **40 GW/a** in 2025.¹

SMA will **expand manufacturing into the US** that will add additional **3.5 GW/a** of production capacity in 2025.²

Why should we add storage to utility scale PV?



EPRI Head: Duck Curve Now Looks Like a Canyon



Source: powermag.com

SMA Solar Technology

Why should we add storage to utility scale PV?



- Money can easier be made out of “prime time”
- Avoid curtailments & shift the energy to the evening
- Enable revenues when the sun isn't up e. g. via energy arbitrage

**Secure Investment | Increase Revenues |
Reduce Risks**

EU negative spot price hours surged to 6,470 in 2023 – Acer

(Montel) The EU's negative day-ahead power price hours surged to 6,470 in 2023, more than 11 times the 558 negative hours seen in 2022, said EU energy regulatory agency Acer on Wednesday.

Source: MONTEL News

Data confirm the rise of solar-plus-storage hybrids across the U.S. grid

Battery prices are falling, and renewable energy generation continues to expand, leading power plant developers to co-locate energy storage along with power generation assets.

Source: PV Magazine



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1 Introduction

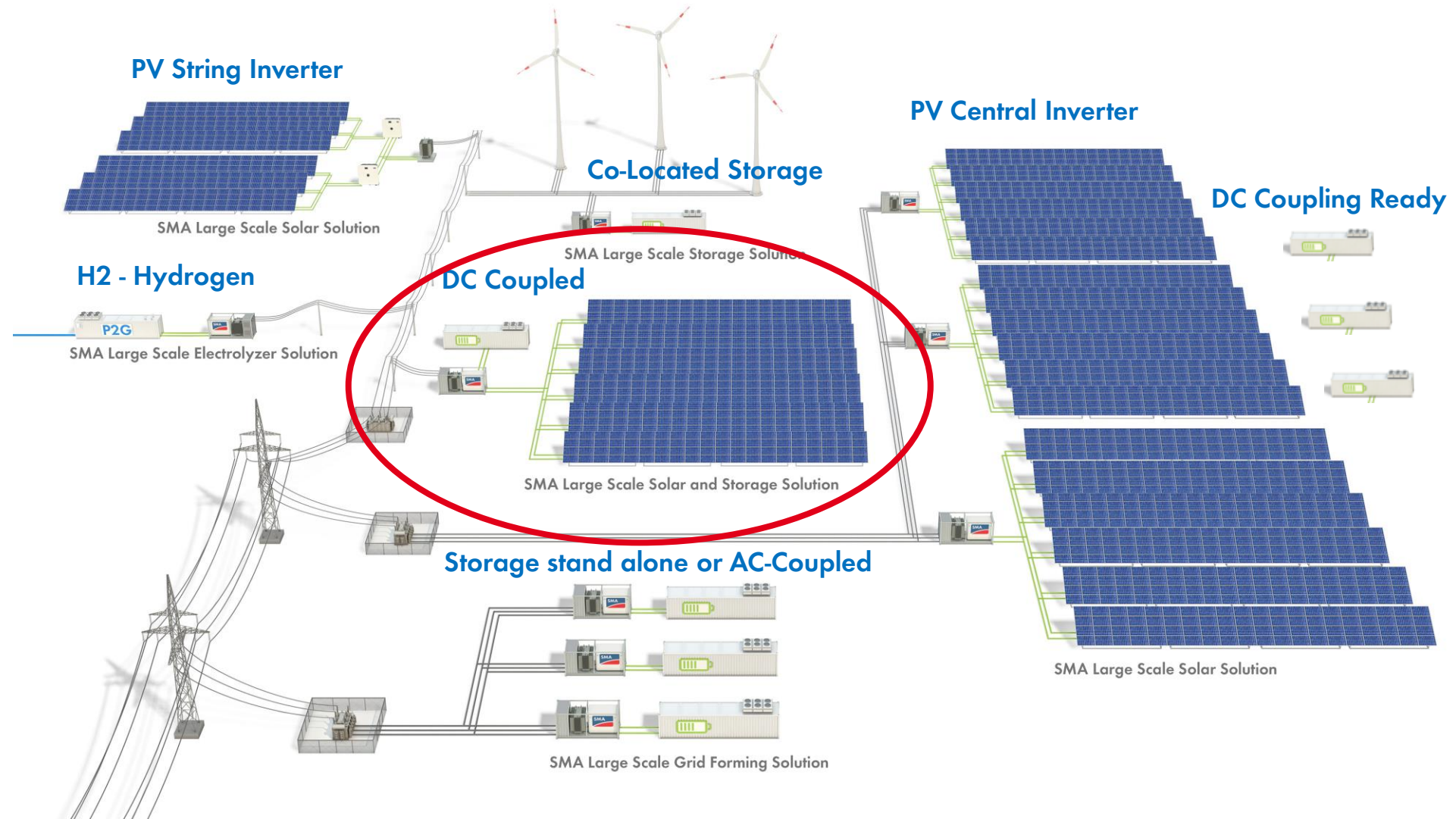
2 Motivation

3 Challenges

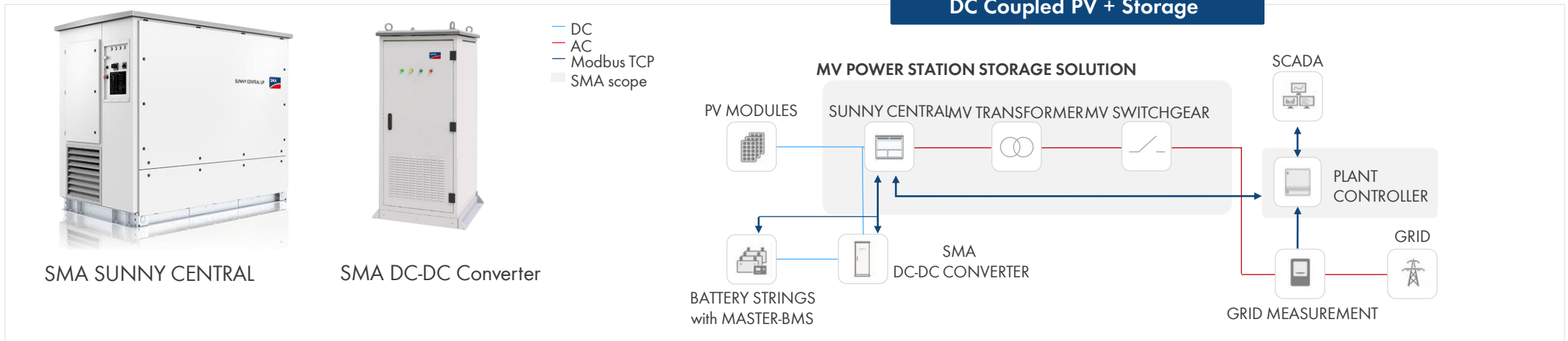
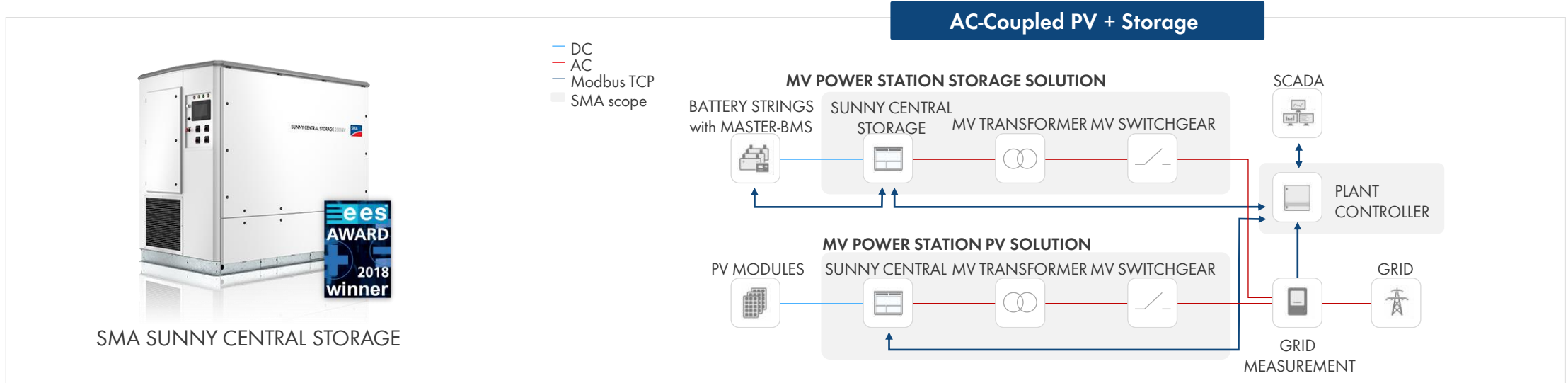
4 Solutions

5 Summary

Overview SMA Large Scale Energy Solutions



Overview AC- coupled vs. DC-couples architecture

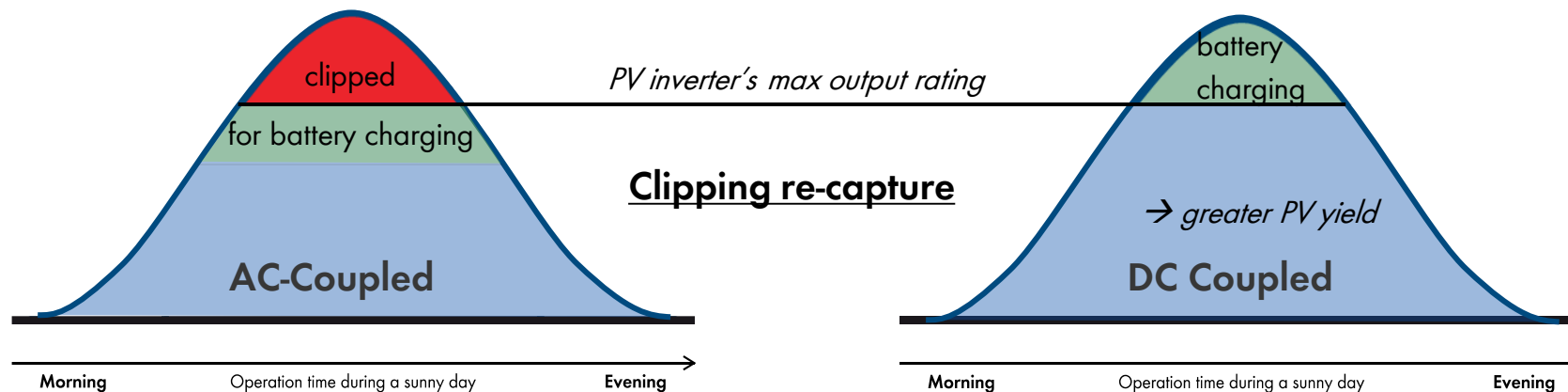


Advantages DC-Coupling

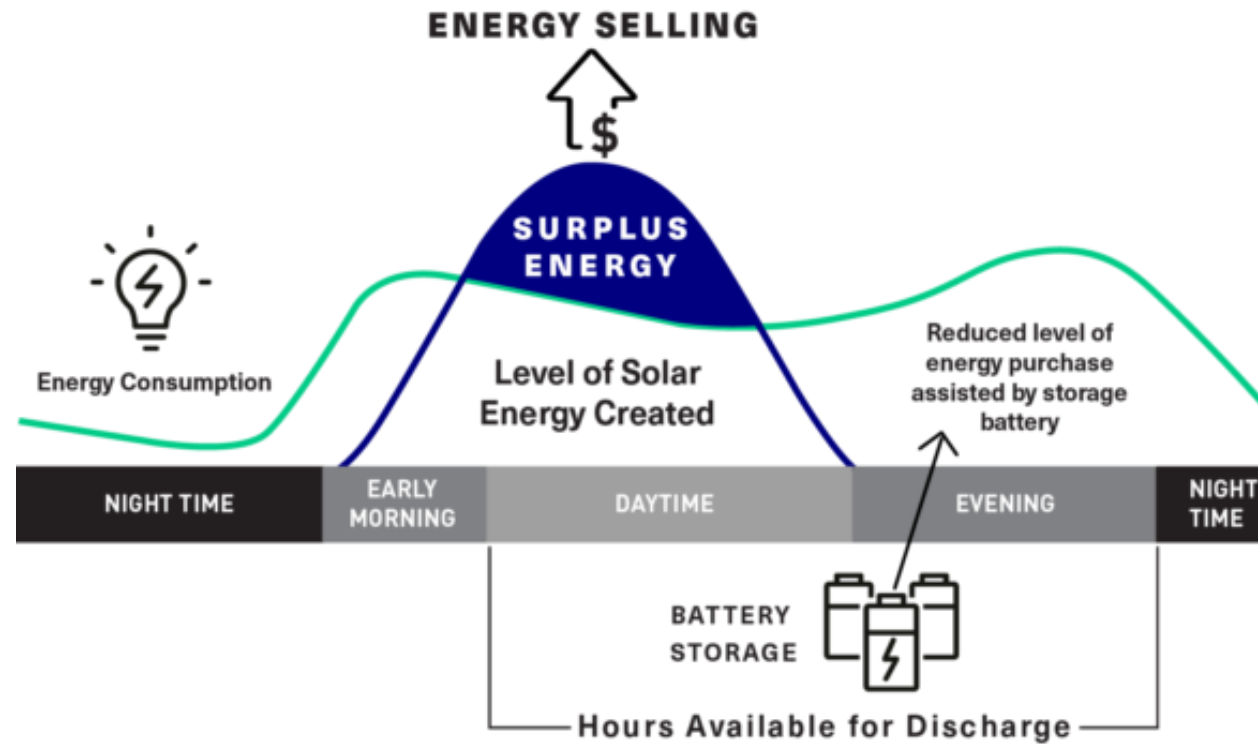


- **Cost Improvements:** Up to 5% more CAPEX & OPEX efficient than AC coupled (less MVPS, Cables, Civil works)
- **Efficiency:** More direct battery charging can enable more than 3% improved round-trip efficiency
- **Sustainability:** Saved hardware, logistics & energy losses improves sustainability
- **Clipping Re-Capture:** Capture clipping losses as revenues in your battery
- **Curtailments:** Enabling your storage to dispatch energy later reduces these risks

As well as keeping general hybrid advantages of **Capacity firming, Grid Support, Energy Shifting and energy arbitrage applications**



Advantages DC-Coupling



Source: Dynapower



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1 Introduction

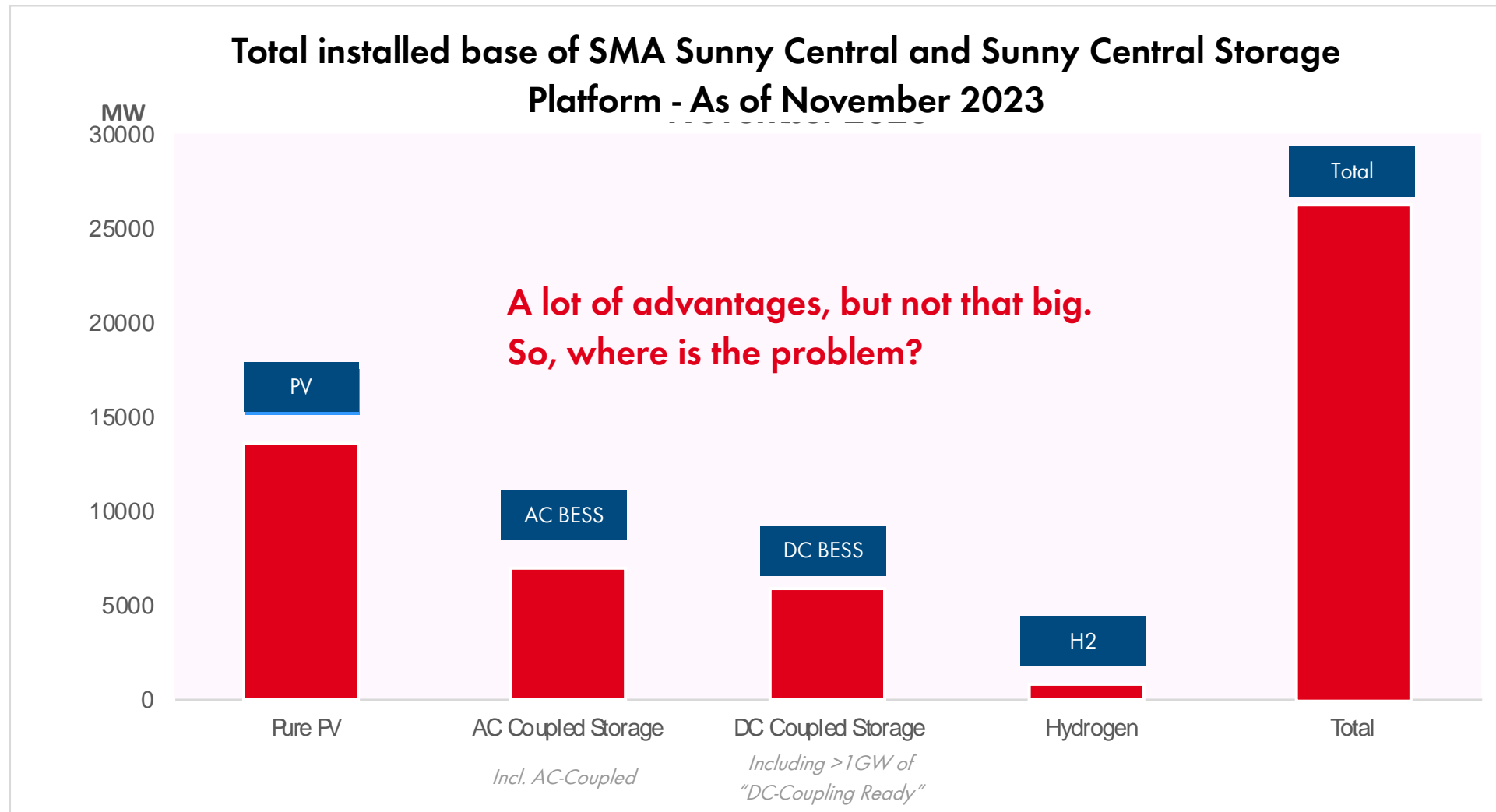
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Total installed volume of current SMA central inverter platform

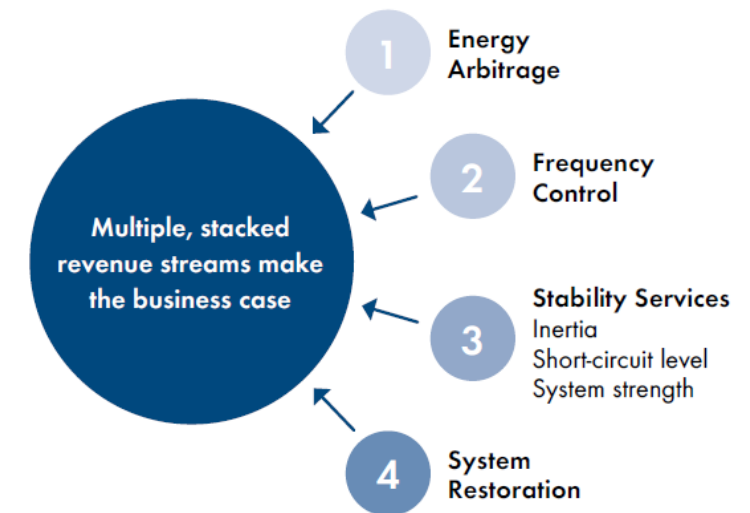


So, why is DC-Coupling not that big, yet?



| Issue | Further details |
|-----------------------------|---|
| Development | Parallel development of two technologies necessary |
| Complex Market | Multi-use in several demanding applications is common |
| Limited market applications | Most solutions weren't able to fully apply on all markets |
| Technological issues | Some solutions experienced a too quick go to market |
| Cost | CAPEX and OPEX savings did often not manifest for first solutions |
| Time | Planning of AC-Coupled projects simpler, hence quicker |
| Management | Higher complexity managing two separate EPCs and independent realizations of different hardware on one site |

Multi use of battery storage





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NEXT LEVEL ENERGY*

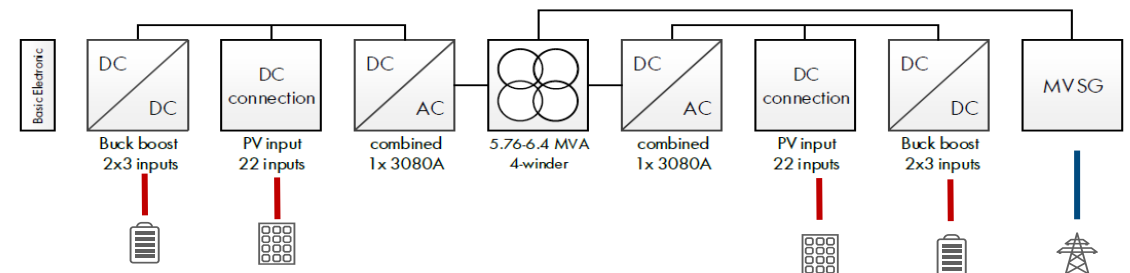


*Details and start of sales coming in Europe June 2024

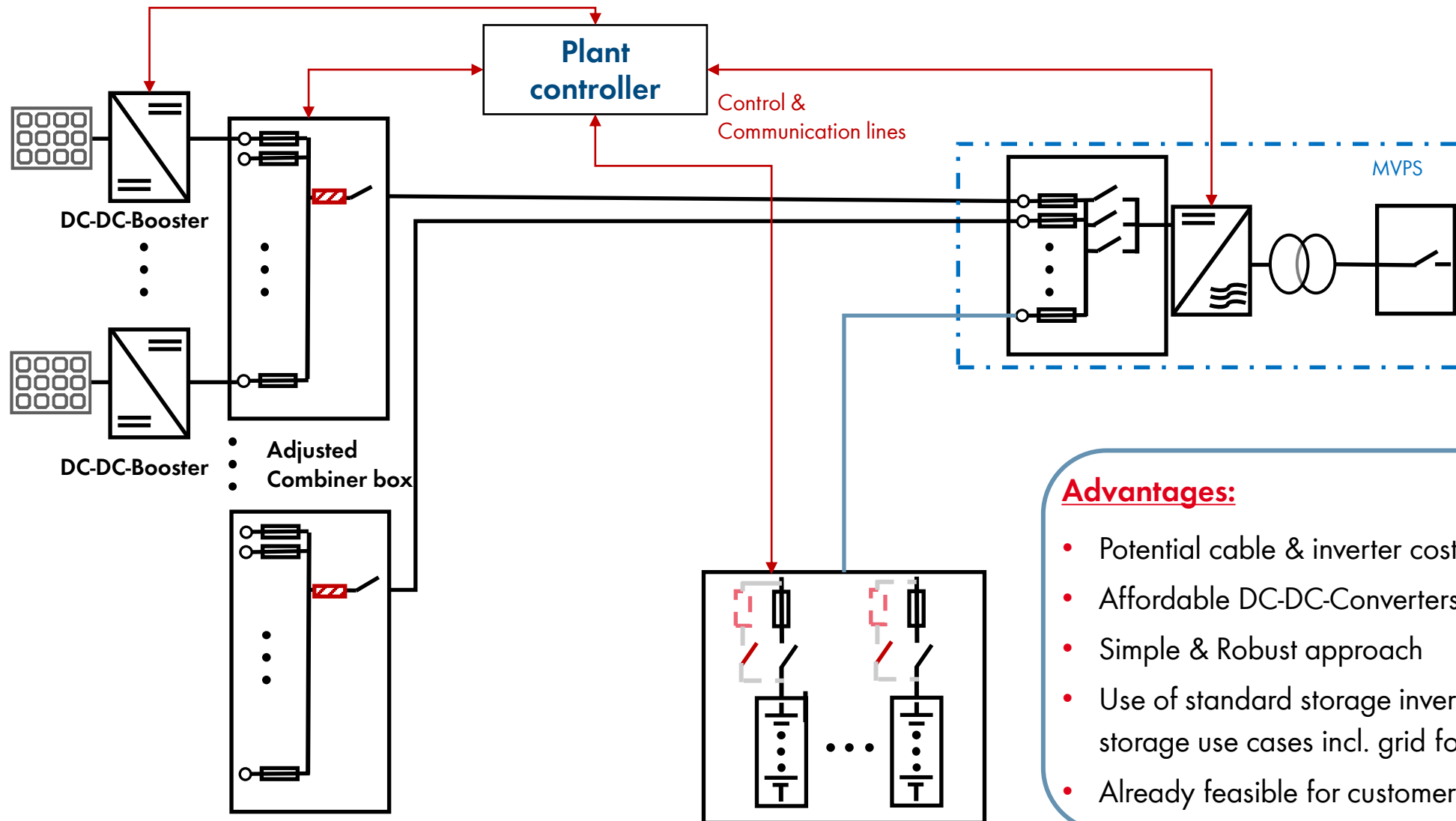
Why the next platform is a potential solution:

- Outstanding efficiency of up to 99,2% AC-DC and 99,5% DC-DC
- Comprehensive one hand solution and platform, incl. DC-DC-Converter
- Fit for all applications, shifting energy, arbitrage, FFR, Grid Forming, ...
- Reduced hardware and balance of plant cost
- Simple integration as one 40' station

PV + Storage integrated into one platform:



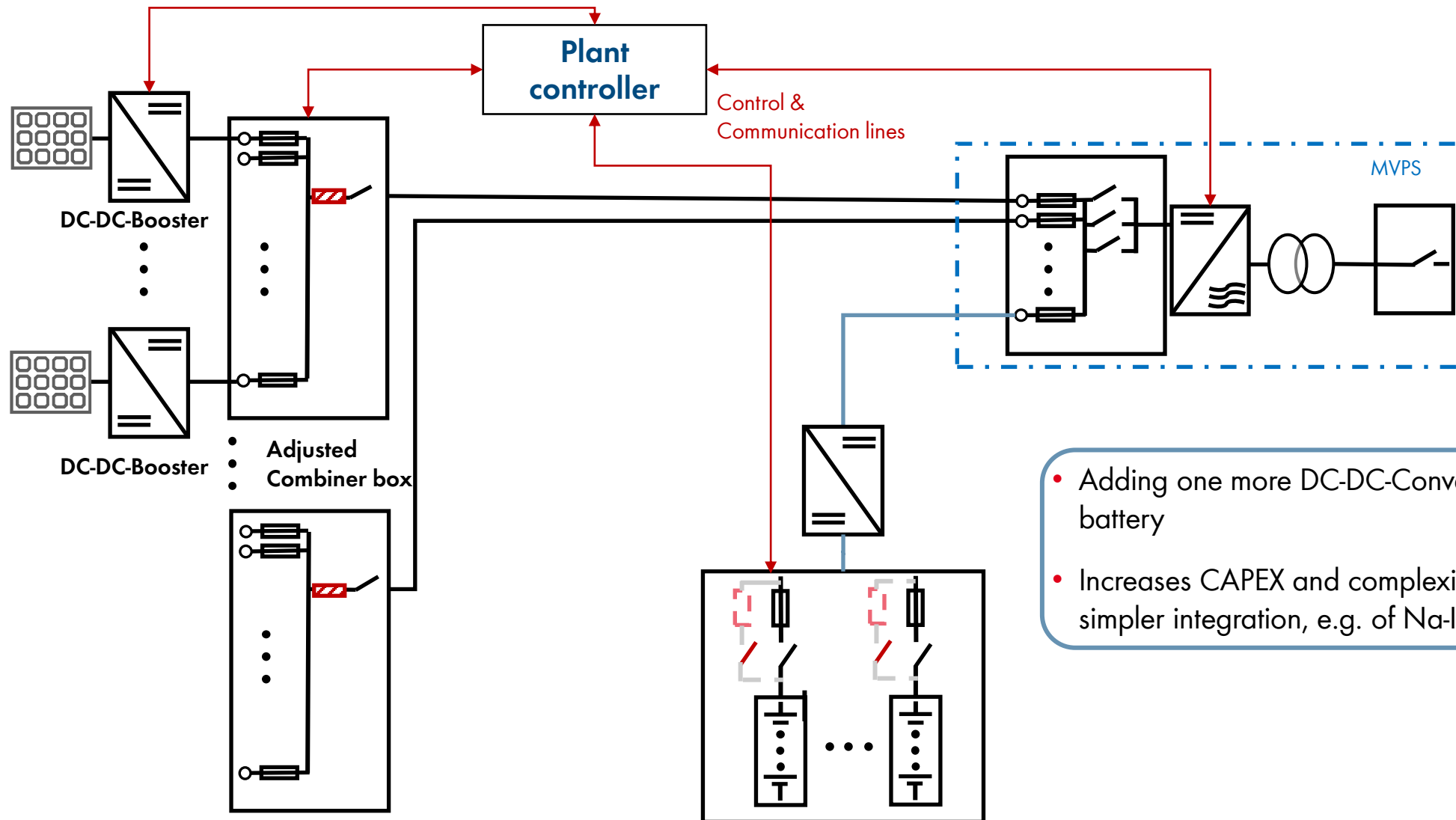
Reverse DC-Coupled system



Advantages:

- Potential cable & inverter cost saving
- Affordable DC-DC-Converters
- Simple & Robust approach
- Use of standard storage inverter, enabling all storage use cases incl. grid forming
- Already feasible for customers

Fixed busbar voltage system



- Adding one more DC-DC-Converter in front of battery
- Increases CAPEX and complexity, but allows simpler integration, e.g. of Na-Ion Batteries

Where do we start with our approach?

No matter whether a new hybrid plant is planned or an existing plant is to be hybridized.



Feasibility study:

Economic optimization can be realized based on the current market situation with up-to-date prices, costs and framework conditions

Planning

Feasibility study:

Last chance to simulate the most economical mode of operation & design to maximize potential Net Present Value

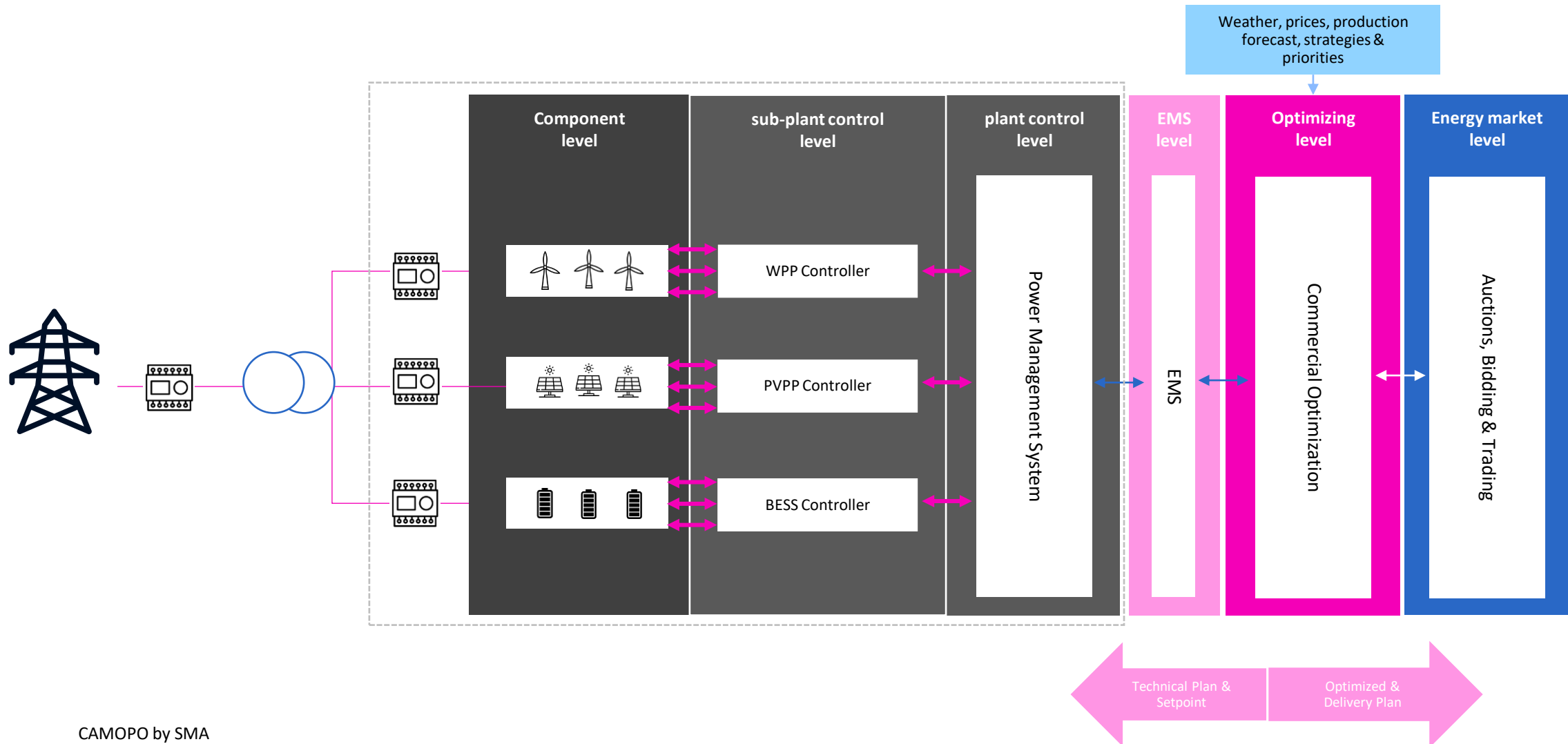
Construction

Software operation:

as an automated brain plans, optimizes and executes daily - around the clock - the most economical operation strategy and thus increases the profitability

Operation

An Optimizer with full-scope EMS is another layer.
It is the intelligence that optimizes your hybrid power plant.





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Are the challenges solved?



| Issue | Solution |
|---|---|
| Development complexity Complex Market | Can be solved with further know how e.g. by CAMOPO |
| Limited market applications Technological issues Cost still to high | Will be solved with new technologies |
| Time demands higher | Solvable with improved tools, experience and better technology |
| Management more complex | Remains challenging needing additional management or full spectrum EPCs |

Thank you for your attention!

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