Hybrid plants done right: designing and operating solar & BESS
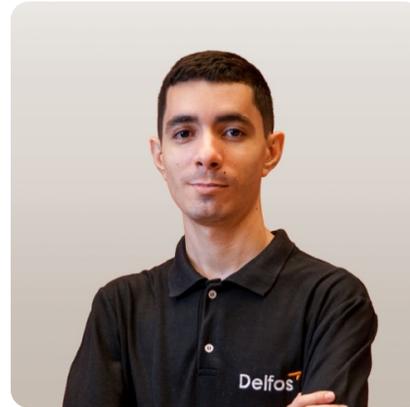
Your speakers today

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RatedPower, the smartest way to design utility-scale solar PV plants
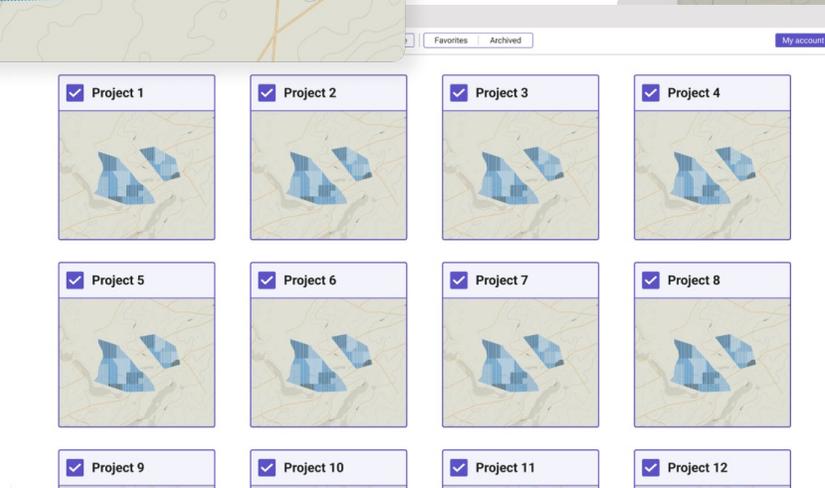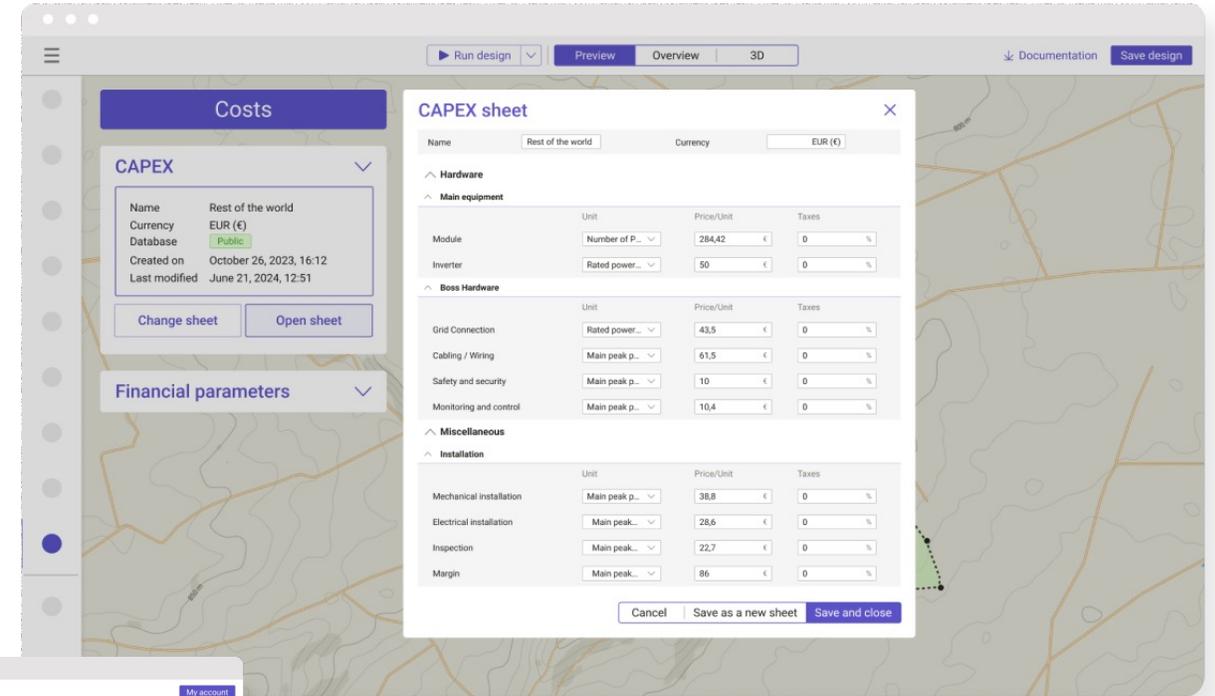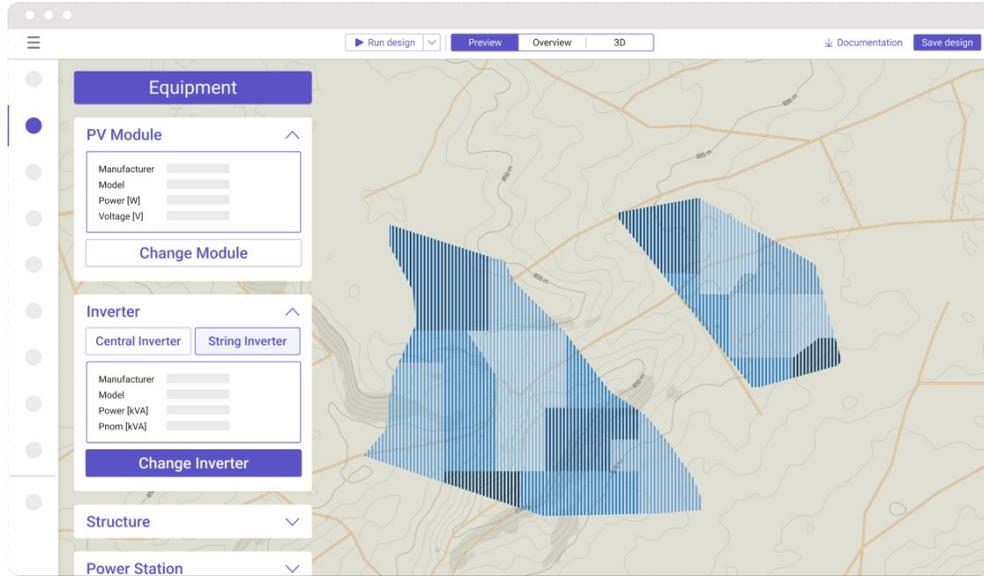
Introduction: RatedPower + Delfos Energy

Delfos Energy helps identify underperformance and failure risks early on operating wind, solar, and storage assets, reducing lost energy and increasing revenue.
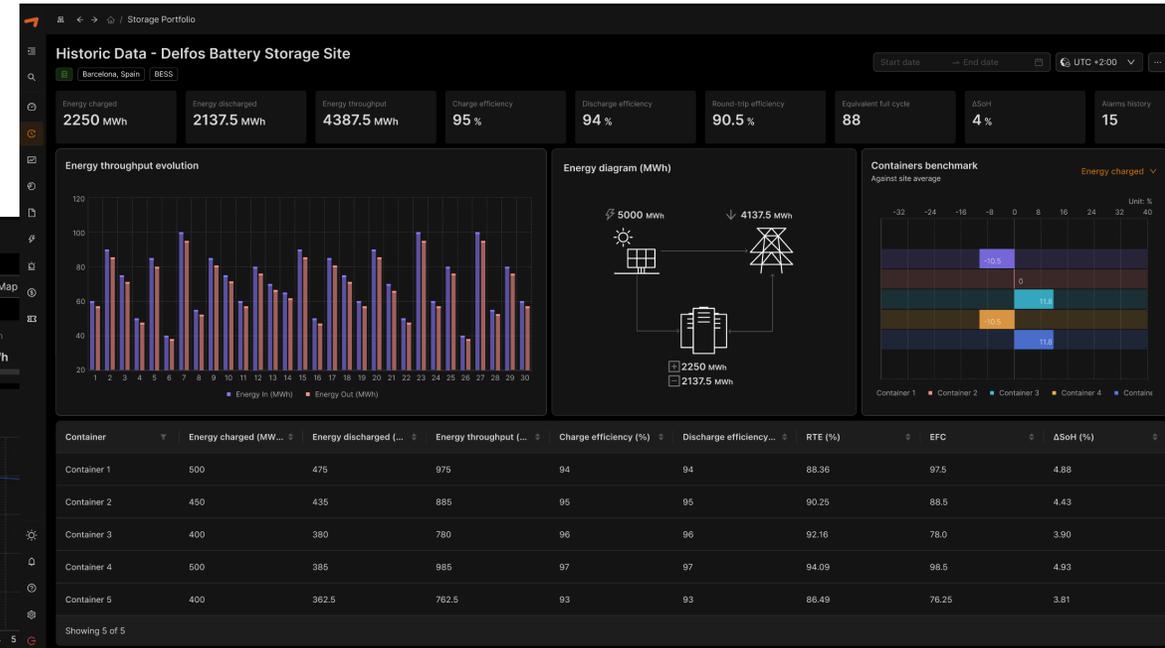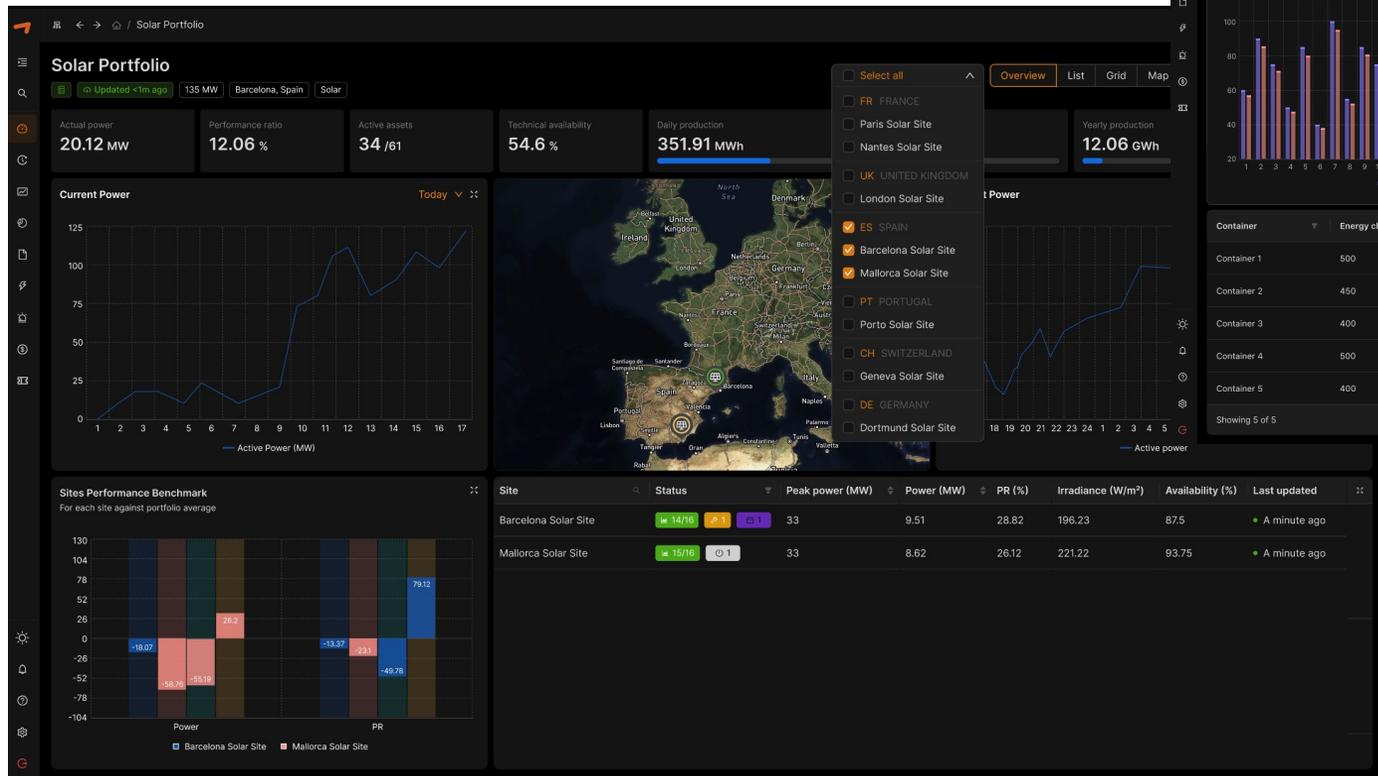
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flow

01. Introduction to BESS

What is BESS?

→ A BESS is not simply storage. It is an asset constrained by power, energy, degradation, grid limits, and market conditions.

→ Every operational decision has a direct impact on long-term value.
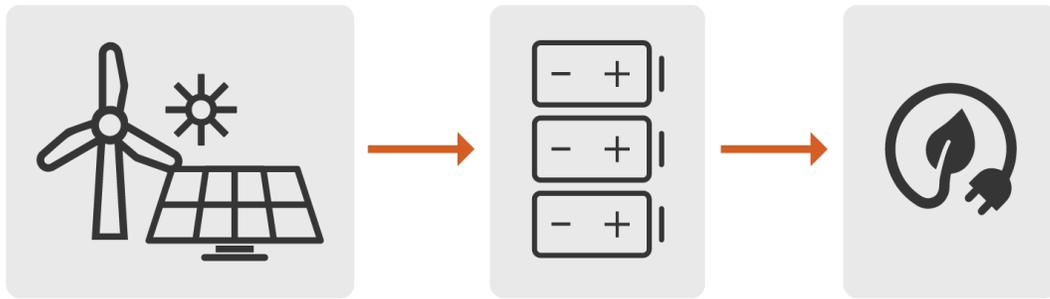
- A BESS added without a dispatch strategy
- Design disconnected from operation
- CAPEX-driven decisions
- Unrealistic operating assumptions

BESS benefits:

→ **Grid Stability:** Hybrid plants provide increased grid stability by integrating solar and battery energy storage, allowing for better management of supply and demand fluctuations, leading to a more reliable energy infrastructure.

→ **Revenue Streams:** By enhancing flexibility and responsiveness, hybrid systems create new revenue streams through services like demand response and ancillary services, optimizing financial performance and return on investment for operators.

02. Designing a solar plant + BESS

Designing a solar plant + BESS

Development Timeline of a Solar Project

Conception
Pre-feasibility Study[1]

Financing and Contracting
Detailed Design

Operations and
Maintenance

3-6 months

6-18 months

25-40 years

6-12 months

12-24 months

Feasibility Study[2]
Permitting

Construction and
Commissioning

Decommissioning

[1]Power Market Analysis, Site Prospection, Financial Feasibility
[2]Financial Analysis, Engineering Feasibility

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What is our PV+BESS objective?

Energy arbitrage	Frequency regulation	Peak shaving	Curtailment recovery

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BESS Connection?

DC Coupled

DC

AC

AC Coupled

DC

AC

DC
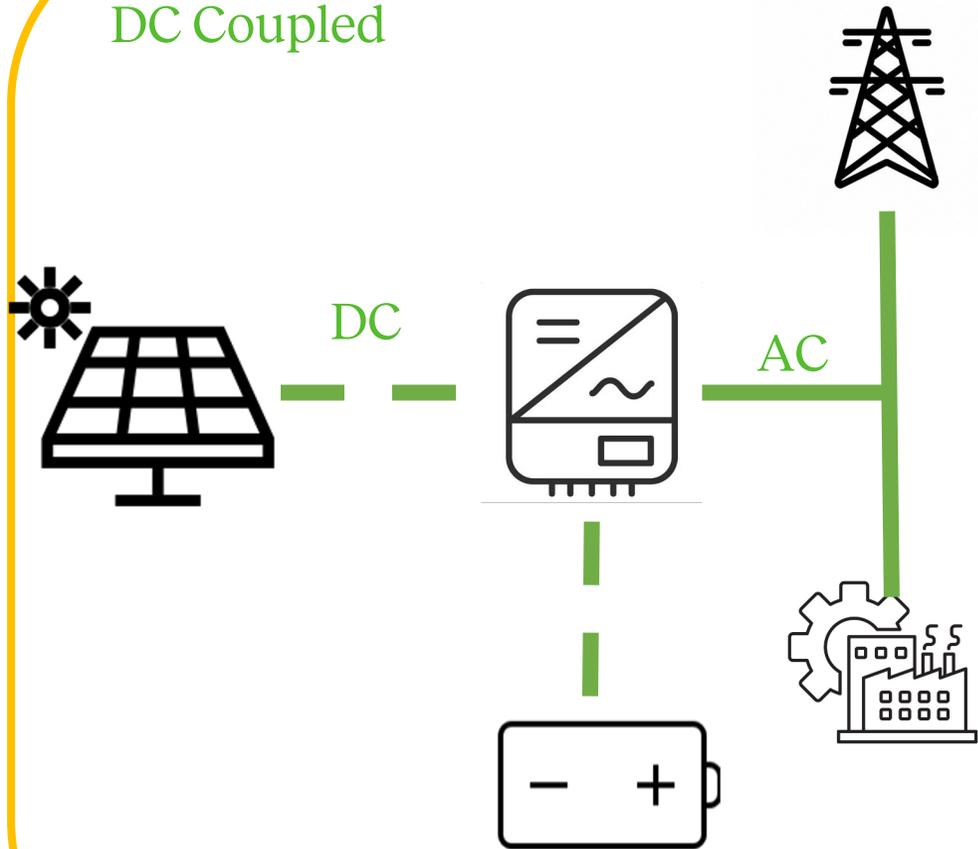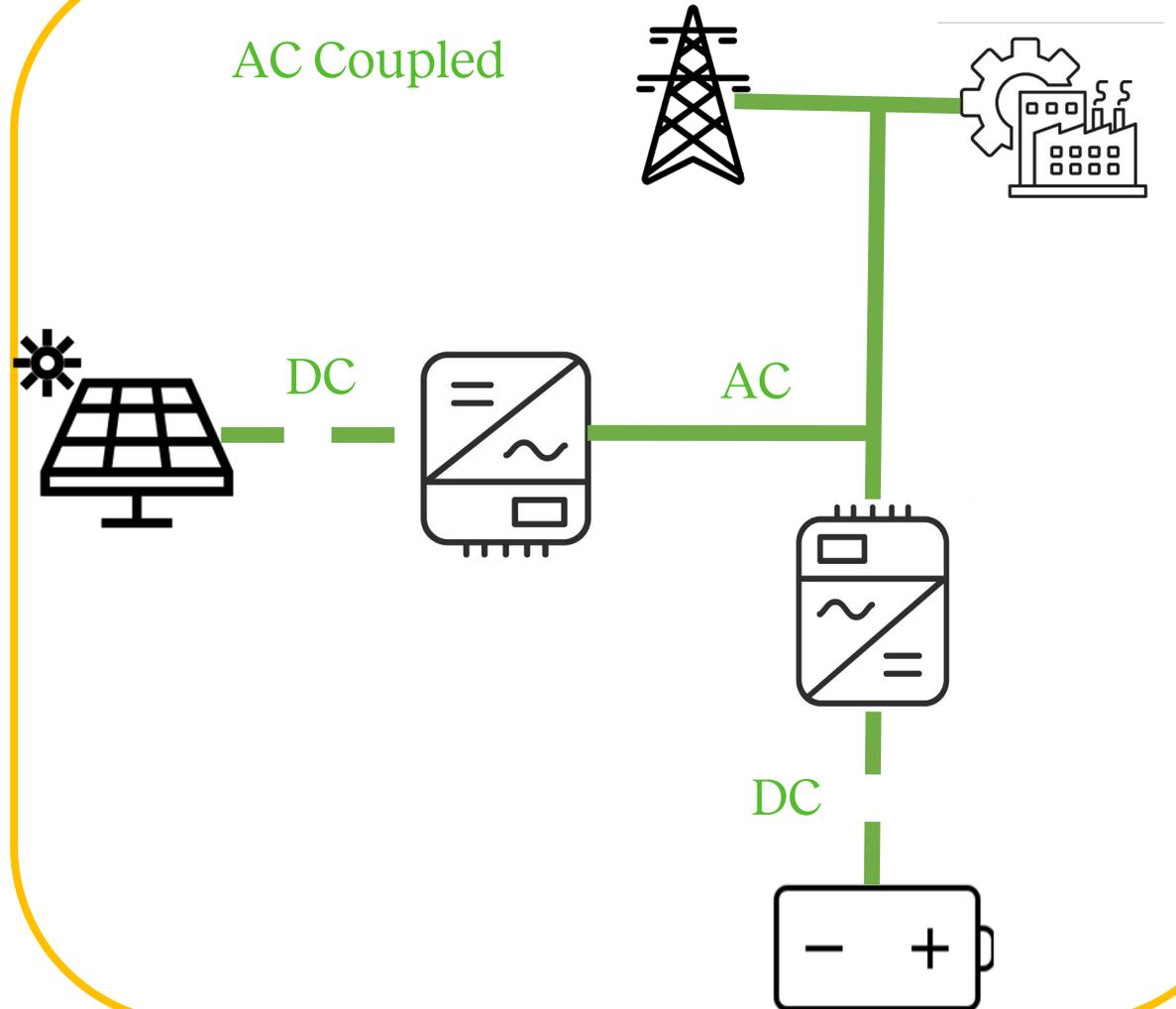
BESS Connection

Revenue Source	DC-Coupled	AC-Coupled
Clipping recovery	Strong	Limited
Curtailment recovery	Strong	Limited
Energy arbitrage	Limited	Strong
Peak shaving / demand charges	Limited	Strong
PPA firming & shaping	Strong	Strong
Ancillary services	No	Yes
Capacity markets	No	Yes
Grid congestion relief	Indirect	Direct
Frequency response (FFR/FCR)	No	Yes
Black start / grid services	No	Yes

DC Coupled
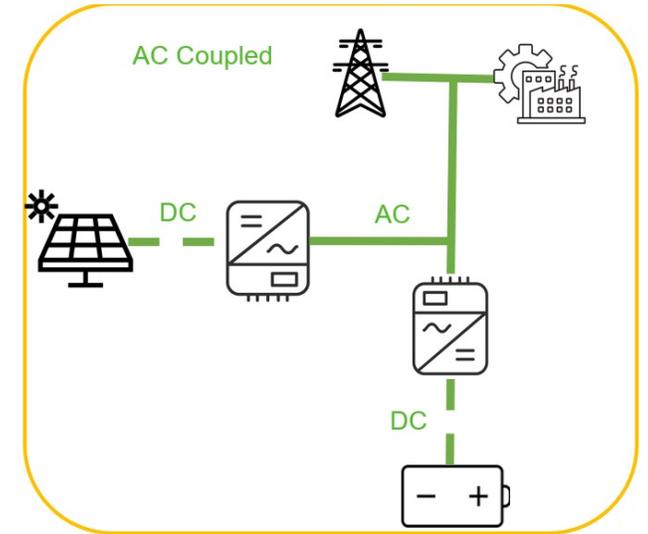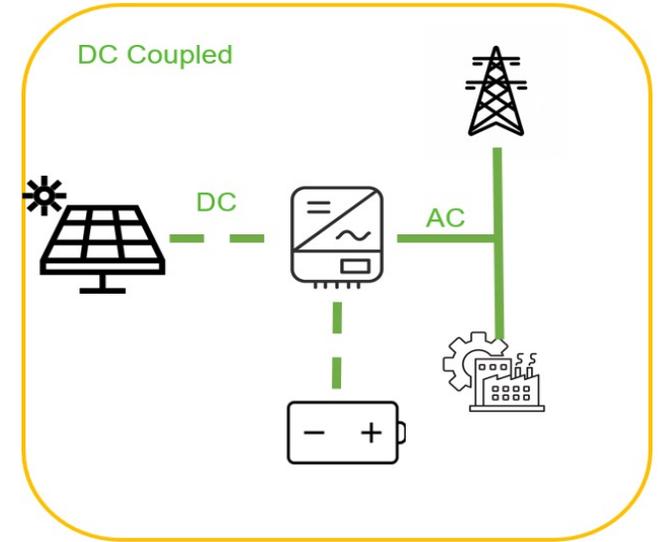
AC Coupled

Designing a solar plant + BESS

RatedPower case study

Site location: Kent, UK

PV module: Bifacial 610 W

Central inverter: 5000 kVA

Structure: East- West 5P

BESS: 150 MW 300 MWh

Objective:

- Find the differences between AC – DC Coupled and impact in its KPI's
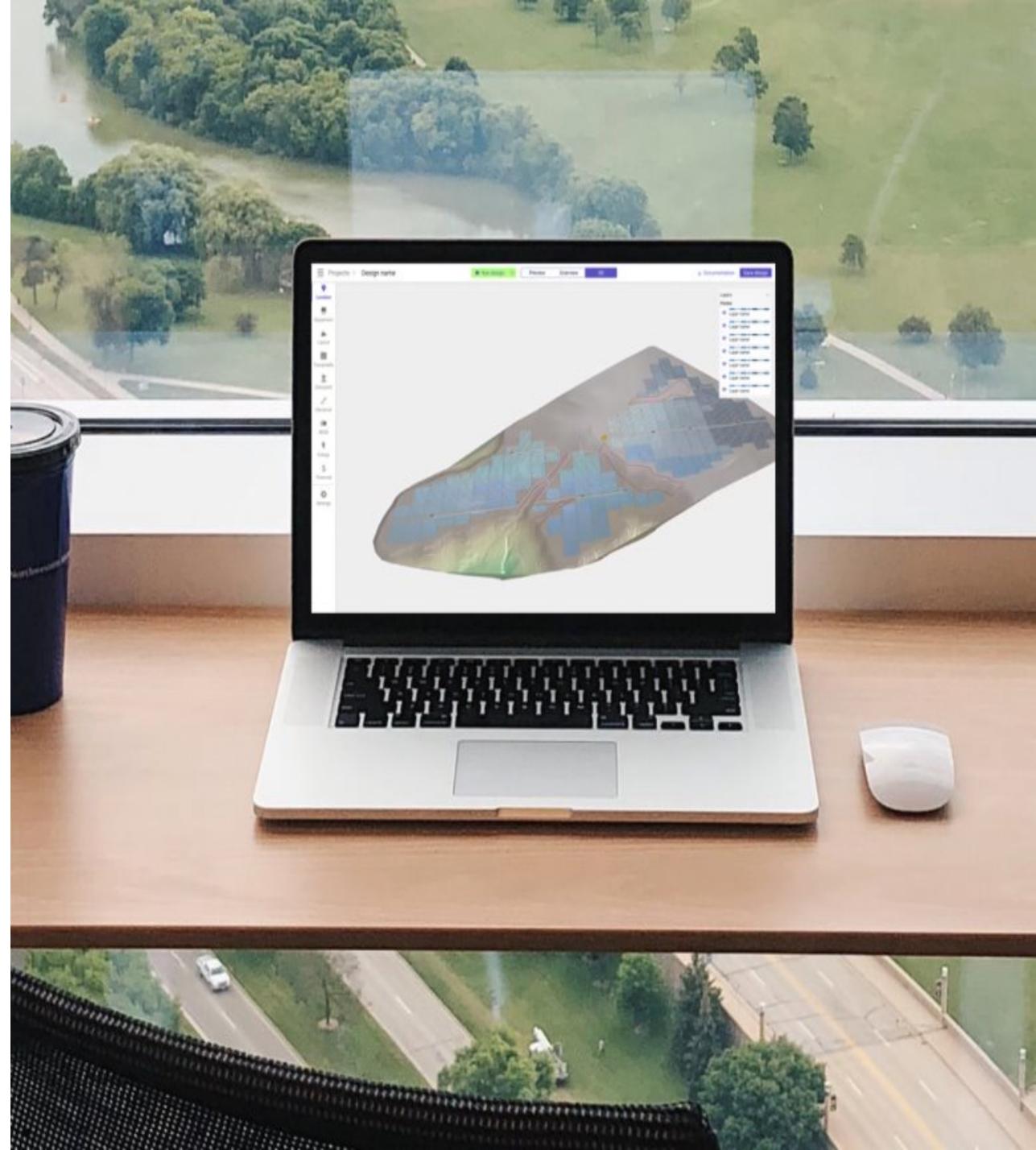
- Compare the results and decide on final design

Tools:

- Comparison tool

- Financial Analysis

Disclaimer: Academic purpose

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03. Operating a solar plant + BESS

Development Timeline of a Solar Project

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Feasibility Study[2]
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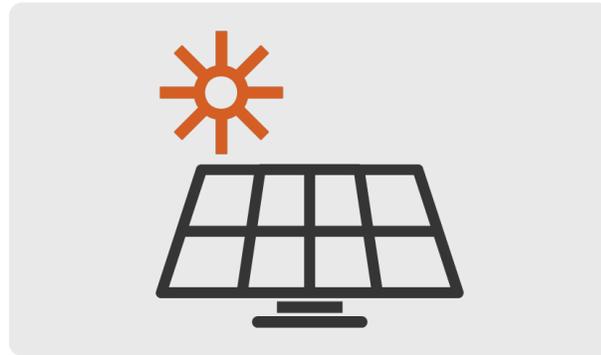[1]Power Market Analysis, Site Prospection, Financial Feasibility
[2]Financial Analysis, Engineering Feasibility

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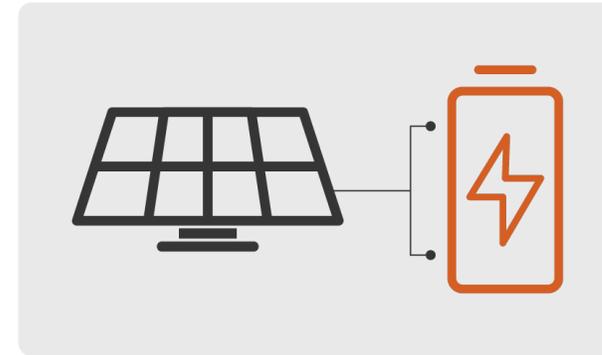
Advanced KPIs and documentation

Standalone

→ Risking your Capex

→ Leaving money on the table

BESS + PV

→ Increase the project potential but also...

→ Doubles the complexity

Driving ROI: tracking the behavior not only the production

Advanced KPIs to Track

→ State of Health (SOH)

→ Round-Trip Efficiency (RTE)

→ Energy Throughput

→ Equivalent Full Cycles (EFC)

→ Avoided Curtailment Energy

→ Revenue per Cycle

BESS Ops Engine

These KPIs provide the critical visibility needed to **balance maximum revenue generation with long-term asset health and warranty compliance.**

Driving ROI: tracking the behavior not only the production

The Digital Warranty Tracker:

A real-time dashboard logging limit breaches (temperature, humidity, energy) to ensure warranty compliance and immediate risk awareness.

Incident logs

Continuous recording of operational anomalies to enable root-cause analysis, recognize failure patterns, and strengthen safety strategies.

Operating a solar plant + BESS

The Digital Warranty Tracker:
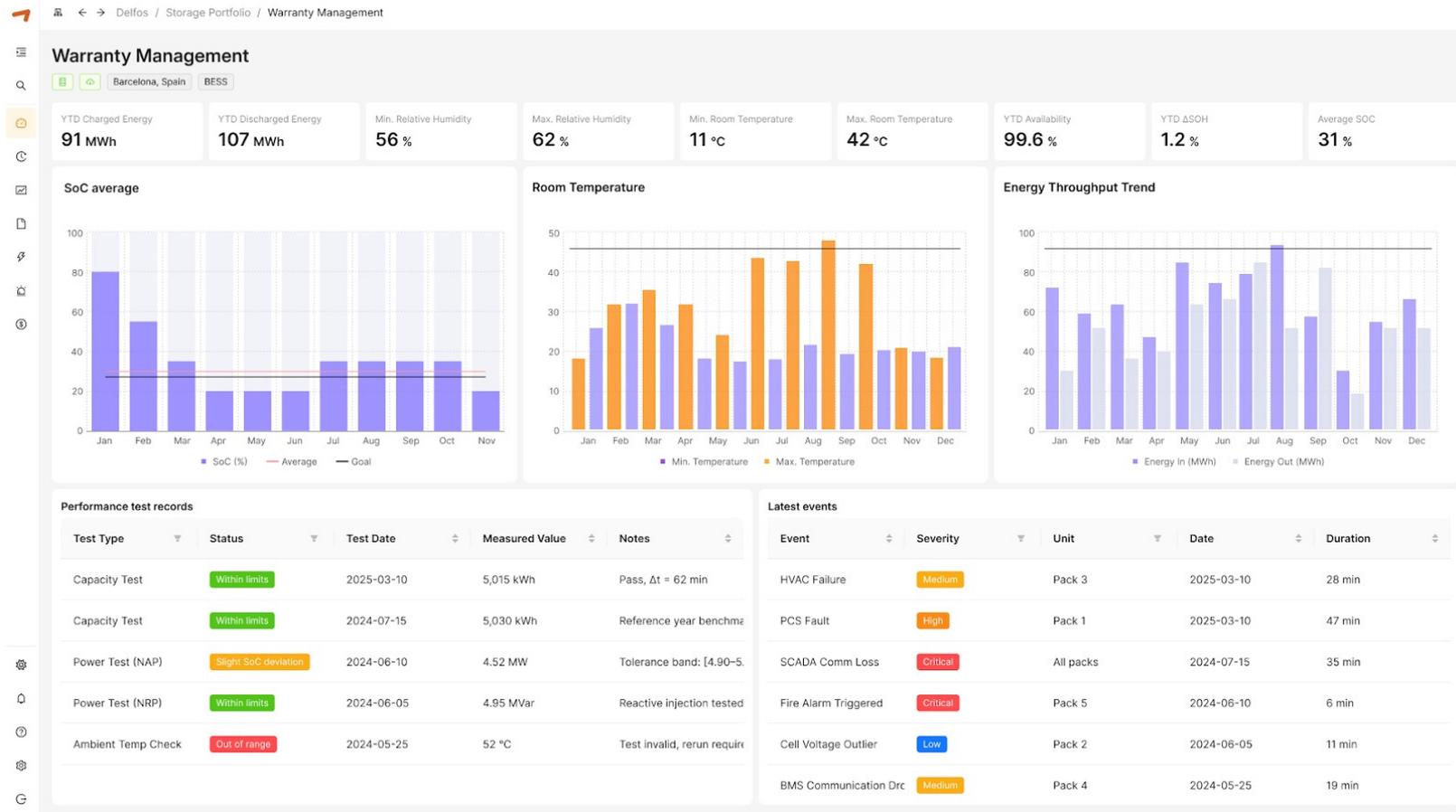
Data-driven Insights & Centralized Portfolios

Data-driven tools

Essential for transforming monitoring into optimization

Centralization

A unified platform is crucial for consistent oversight and data integration.

Delfos Energy case study:
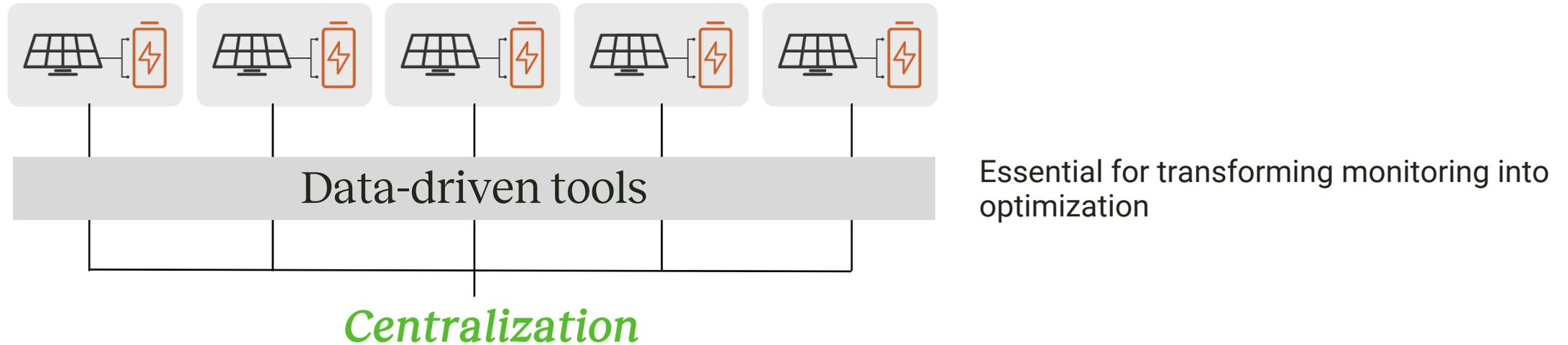# Day-Ahead Revenue Optimizer

Forecasted solar production and day ahead energy price

- Company strategies are implemented as boundary conditions

- Physical characteristics are considered: maximum discharge rate, charge and discharge efficiencies etc.

Objective:

- Automate bidding strategies to maximize market revenue while protecting the asset.

Optimization Strategy for Hybrid Power Plant (PV Plant + BESS)

💵 **Market Specification**

Select a Market:	Select the kinds of operation:	Day	Positive imbalance price rate	Negative imbalance price rate	Price forecasting strategy:
MIBEL	Day ahead	2025/10/01	0,90 − +	1,10 − +	Perfect Foresight

❋ **PV Plant Specification**

Power rated (MW)

25 − +

🔋 **BESS Specification**

Power rated (MW)	Energy capacity (MWh)	Charge efficiency	Discharge efficiency	Initial SOC (%)
6 − +	13 − +	0,95 − +	0,95 − +	60 − +

Curtailment Simulation

Include event of curtailment:

No

Show

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The Foundation: Data Quality

Trust Your Data

Flawed data leads to "Bad Dispatch"—where a 5% SOC error can cause a costly system trip.

Automated Validation

Real-time checks to instantly flag frozen sensors, missing signals, or outliers.

Redundant Sensing

Use backup meters to cross-validate measurements and catch faulty hardware early.

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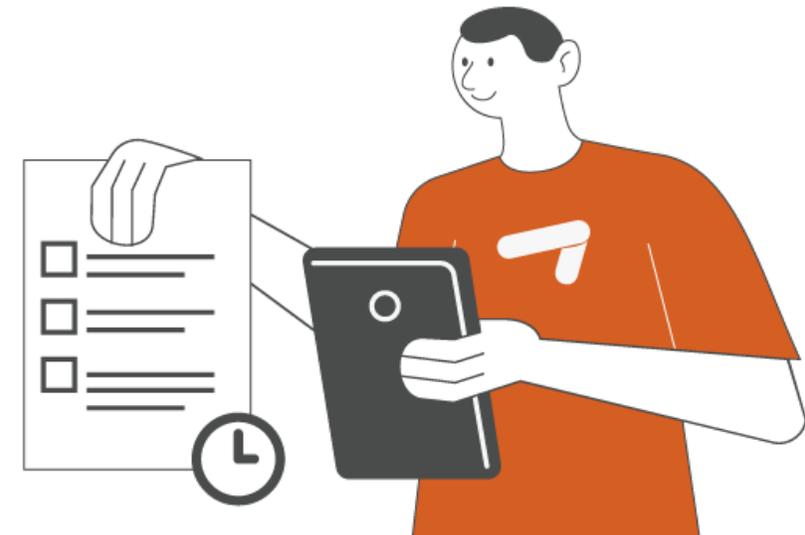
04. Main strategies for ROI maximization

Main strategies for designing a PV + BESS project:

- **Revenue strategy drives design:** Coupling choice (DC vs AC) determines which revenue streams are permanently accessible.

- **Coupling choice locks long-term ROI:** DC maximizes PV value (clipping/curtailment); AC unlocks market and grid services.

- **Sizing ratios matter more than CAPEX:** DC/AC ratio, BESS MW/MWh, and inverter headroom define revenue ceilings.

- **Design must reflect real operation:** Degradation, cycling limits, grid constraints, and dispatch logic must be included from day one.

- **Grid and market rules are ROI constraints:** Interconnection limits and market access shape achievable returns as much as technology.

- **Design and operations must be aligned:** Projects designed with operational KPIs and dispatch in mind consistently outperform.
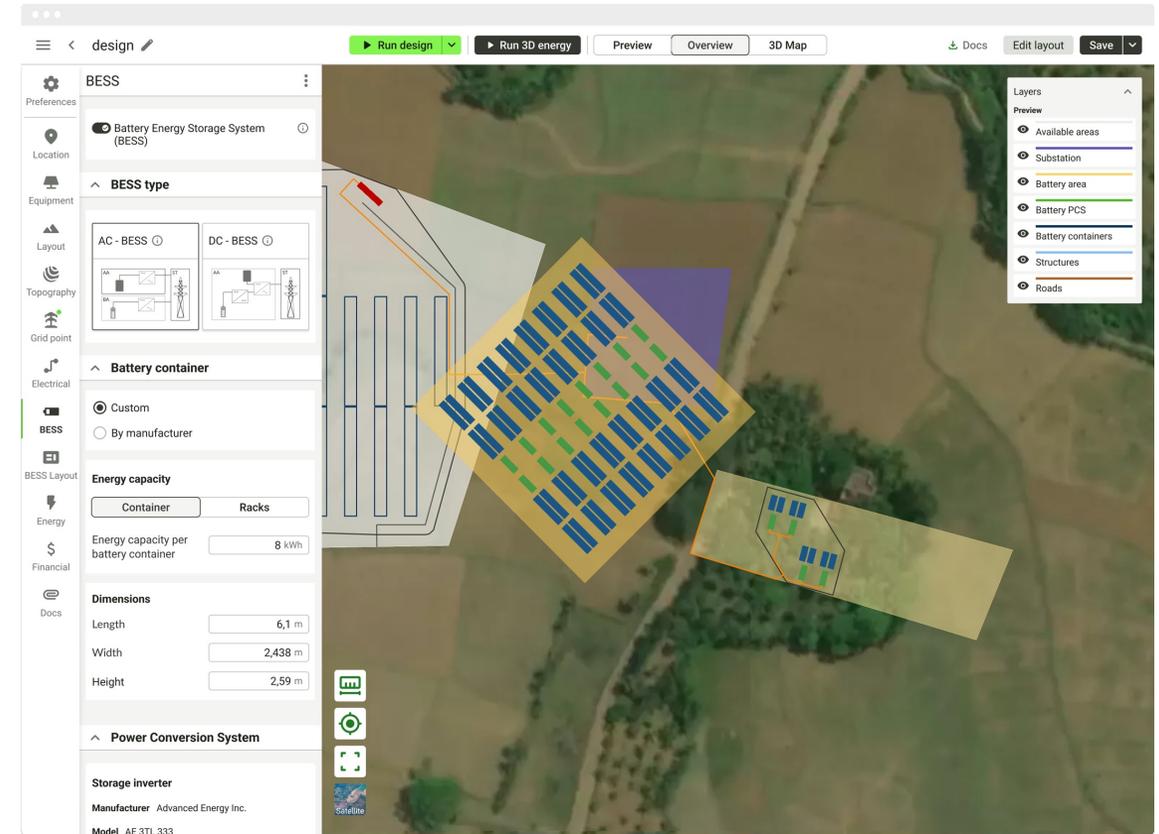
Main strategies for operating a PV + BESS project:

- **Review your O&M Contract**: Does it include SOH, RTE and the other KPIs we mentioned or just 'availability'?

- **Digitize your Warranty:** Stop using PDFs. Move your temperature and cycle limits into an automated alert system.

- **Centralize your data:** Do you have a single source of truth that consolidates all operational, performance, and warranty-critical data across sites, enabling consistent insights and faster, data-driven decisions?

- **Review your Data Quality routines:** Do you have tools to auto detect data quality issues? Do you have enough backup sensors, or could this number be improved?

- **Keep our KPI playbook close**: what each metric means and why it matters.

Designing a hybrid system is the first step. Operating it with 'eyes wide open' is where the ROI is truly won.

Let's talk! Book your Delfos demo for a live walkthrough **tailored** to your assets and data flow.

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05. Q&A Session

Questions?

We're all ears!
Drop yours in the question box!

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