Efficient deployment of hybrid assets

Learnings from across Europe on collocated BESS

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Specialist and growing consulting firm

Putting people first. Creating impact that lasts.

Our purpose is to create a distinct and innovative consulting experience by **genuinely partnering** with our clients and bringing exceptional **Energy subject matter expertise**.

- ✓ Professionals across the **UK, Europe, Singapore, North America, Asia and Australia**
- ✓ Led by 100+ market-facing partners, who are **subject matter experts in our industries and capabilities**
- ✓ Operationally-minded, **specialist consultancy with proven IP** to understand problems and **deliver bespoke, innovative solutions**
- ✓ Consistently **ranked as one of the leading Energy consulting businesses**

Our

2,000+

professionals globally can support you across geographies from **power market landscapes and analysis** to **strategy creation**.

Our award-winning culture attracts the brightest people

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About Baringa's Energy & Resources Capabilities

Baringa is an award-winning business and technology consultancy, rated number 1 by the FT in energy and utilities

300+ Energy Clients

#1 Energy and environment consultancy

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- Gold: Energy, Utilities & Environment
- Gold: Oil & Gas

- We currently employ 800+ consultants who specialise in the energy sector.
- We are recognised as the top ranked consultancy in the Energy and Utilities sector in the recent Financial Times survey of clients and peers, for the third year in a row.

Over 800 Consultants in the Energy Sector work across the whole value chain in Europe, US & APAC, combining deep sector expertise with our leading-edge capabilities

- **Generation & Investment**
- **Transmission & Distribution**
- **Smart assets & infrastructure**
- **Supply & Retail**
- **Customers**

Baringa Climate Change Solution

At Baringa, **climate change is our number one priority and we have made it a key pillar of our purpose-led strategy**. It has formed the core of our business for the last 20 years.

We have developed the market leading climate change solution, which we are now taking through our partnership with Blackrock to the global market for climate risk reporting.

Baringa

A strong local team leveraging 25 years of international experience in energy consulting

Our Rotterdam team of experienced consultants with deep insight in the Dutch energy market helps you navigate the challenges of the energy transition, building on our international expertise and successful solutions from the markets we work in across Europe, and beyond.

Our market and commercial advisory focuses on the business case for battery energy storage systems and other energy storage technologies and flexible assets

Storage market entry report

- ✓ Comprehensive reports covering the key elements of the **energy storage business case,** including: market drivers for BESS (Battery Energy Storage Systems) and other storage technologies; routes-to-market, revenue streams and stacking strategies; regulatory considerations; market structure and competitive landscape; location considerations; BESS as an infra play

Route-to-market advisory

- ✓ **Detailed assessment** of a route-to-market contract for a specific project
- ✓ **Red flag report** providing a critical appraisal of **optimisation services contracts**
- ✓ Policy, market and commercial support during **negotiations with potential offtakers** to ensure fair value is shared with the asset owner

Technical advisory

- **Review of the specification** to identify unusual methods of construction or complex and unique approaches;
- Comment on the commissioning, handover and interface procedure and the resultant risks carried into operations;
- Security package offer
- Comment on the suitability and adequacy of any surviving defect liability period and regime

Asset revenue projections

- ✓ **Asset-specific analysis: Gross margin projections** for both standalone and co-located BESS assets taking the detailed technical and commercial characteristics of the project into account
- ✓ Results may include several elements, including: capacity mechanism, day-ahead, intra-day, balancing mechanism and balancing services revenues

Hybrid asset configuration

- ✓ **Sizing of various elements** (e.g. BESS, grid connection, RES installation) to assess their contribution to business case
- ✓ Impact of operation of an (inflexible) asset on the operation of the flexible asset
- ✓ Run BESS in service of other asset instead of pure merchant optimisation

Focus of this talk

Efficient deployment of hybrid storage means ensuring storage can act across all markets, but also that capital is deployed where best used

Efficient support schemes:
How does our support scheme provide most societal value?

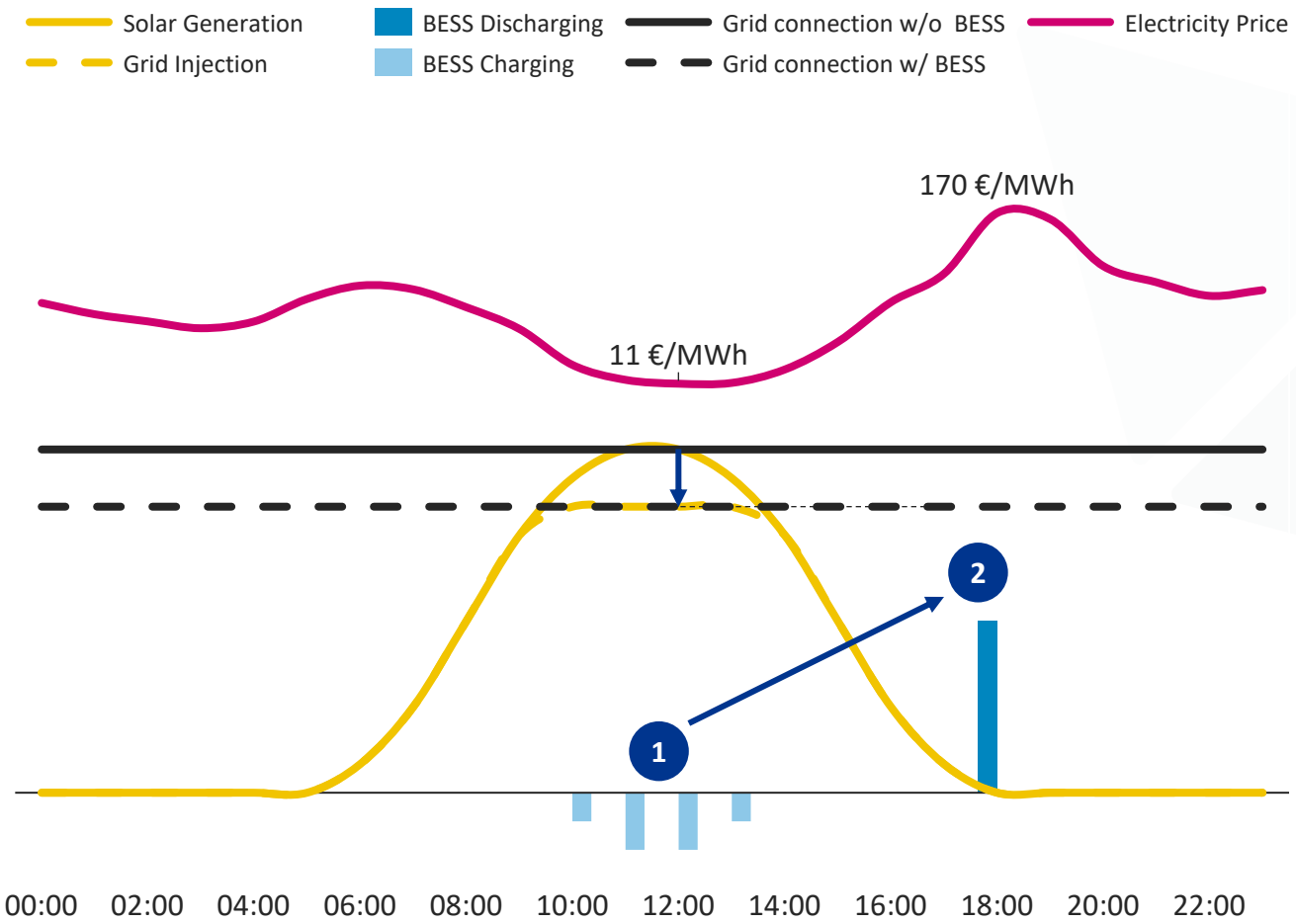
Efficient deployment of capital:
Where do I earn the highest return on my investment?

Efficient connections:
How can we connect as many MWs as fast as possible across RES/storage?

Efficient use of storage:
How is asset flexibility maximally made available to the system?

Delayed feed-in of solar is the most familiar of all cases, focused on reducing curtailment and boosting capture prices – but do not ignore other markets!

Indicative 24h-operations of a solar plant with collocated BESS

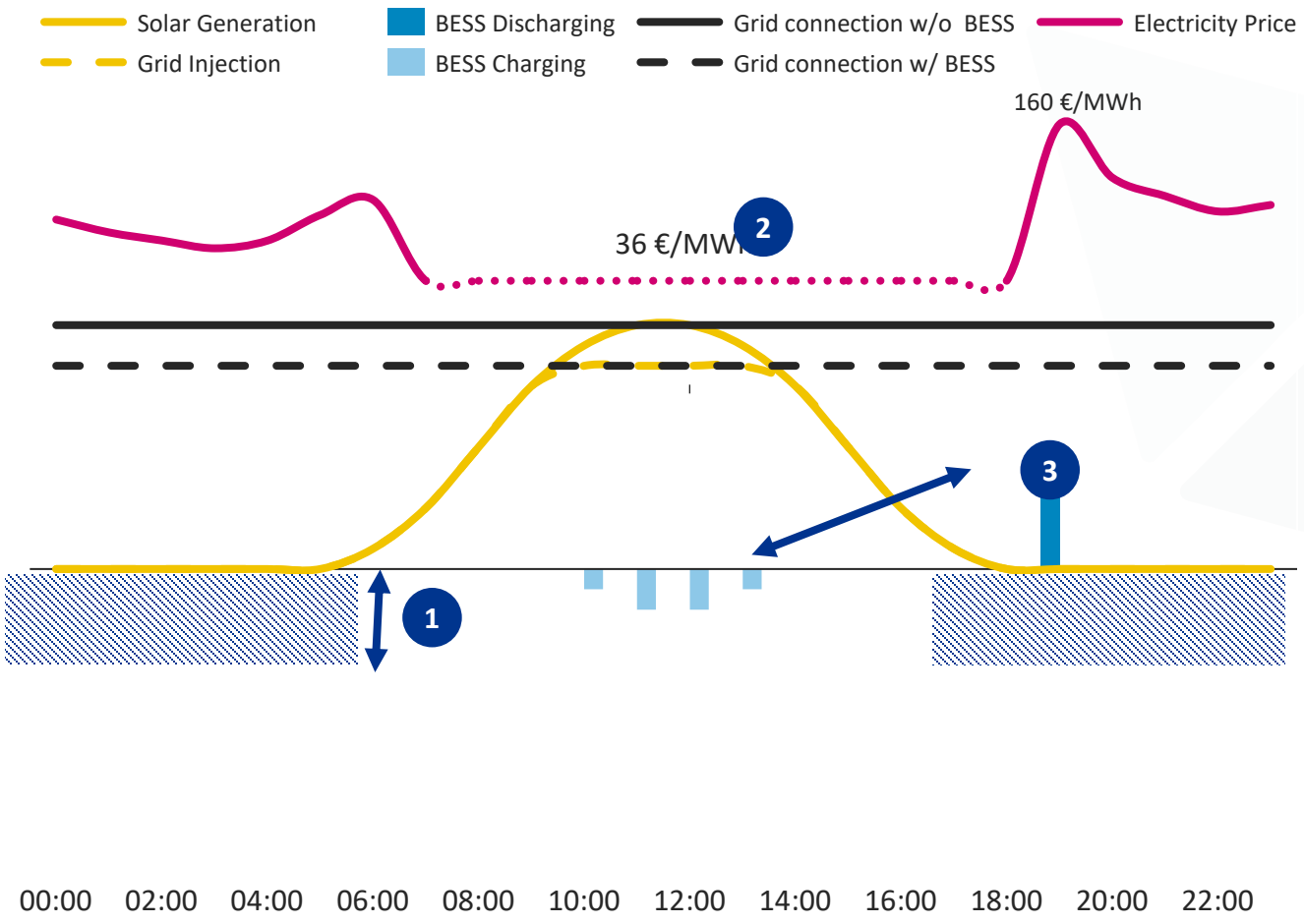


- The grid export connection capacity can be reduced as the BESS can be charged when the solar production is close to maximal (1) and discharged at peak prices (2).
- Charging the BESS with generation from a collocated solar plant avoids importing electricity from the grid and any associated costs.
  - This avoidance of grid charges is effectively a boost to arbitrage value
  - we see values from 30 EUR/MWh (Romania) to 100+ EUR/MWh for residential storage.
- During nighttime, the battery is effective across ancillary services, balancing, or further wholesale arbitrage.

A simple idea, let's see how support schemes can make them less efficient.

Greece is going back and forth on collocated support schemes, the discussion centers on interaction with existing CfD contracts and limits to drawing from grid

Indicative operation under Greek support mechanism



Greek support for collocated battery+solar assets focuses on retrofitting solar plants, accelerating licencing and providing financial support.

1. As a pre-condition the battery cannot charge from the grid.
2. Discharge during daytime hours is at the solar CfD strike price….
3. …reducing arbitrage opportunity for the batteries.

Ancillary services provision is hardly possible due to take-from restriction.

Assets are considered as fully renewable, but at a great societal opportunity cost.

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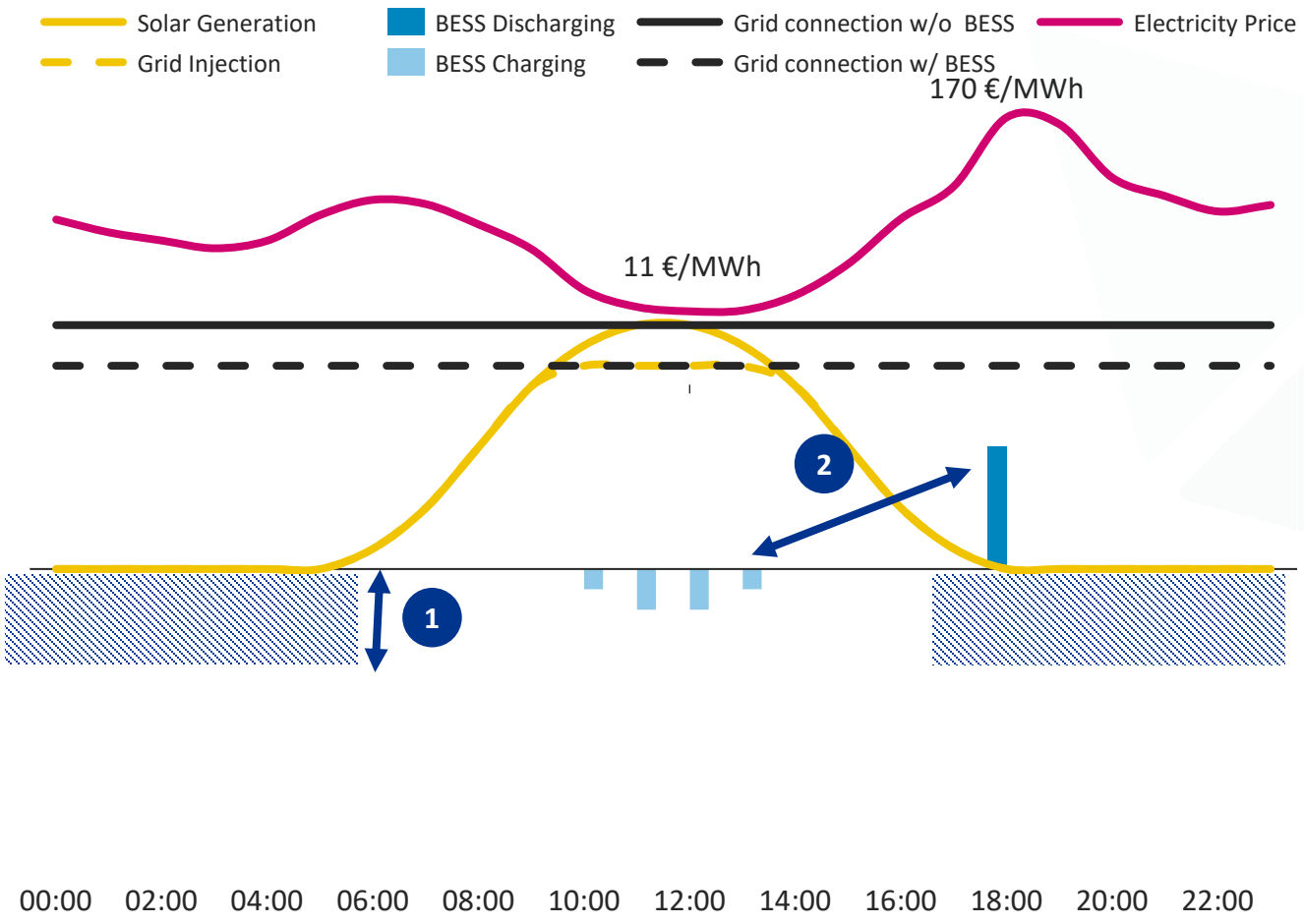
The German innovation tender supported the buildout of collocated BESS with solar PV, but the limits to feed-from-grid made the business case challenging

Indicative operation under German innovation auction



The Innovationsausschreibung in Germany provided a subsidy per MWh for up to 20 years.

1. As a pre-condition the battery cannot charge from the grid.
2. The regular arbitrage opportunity remains available.

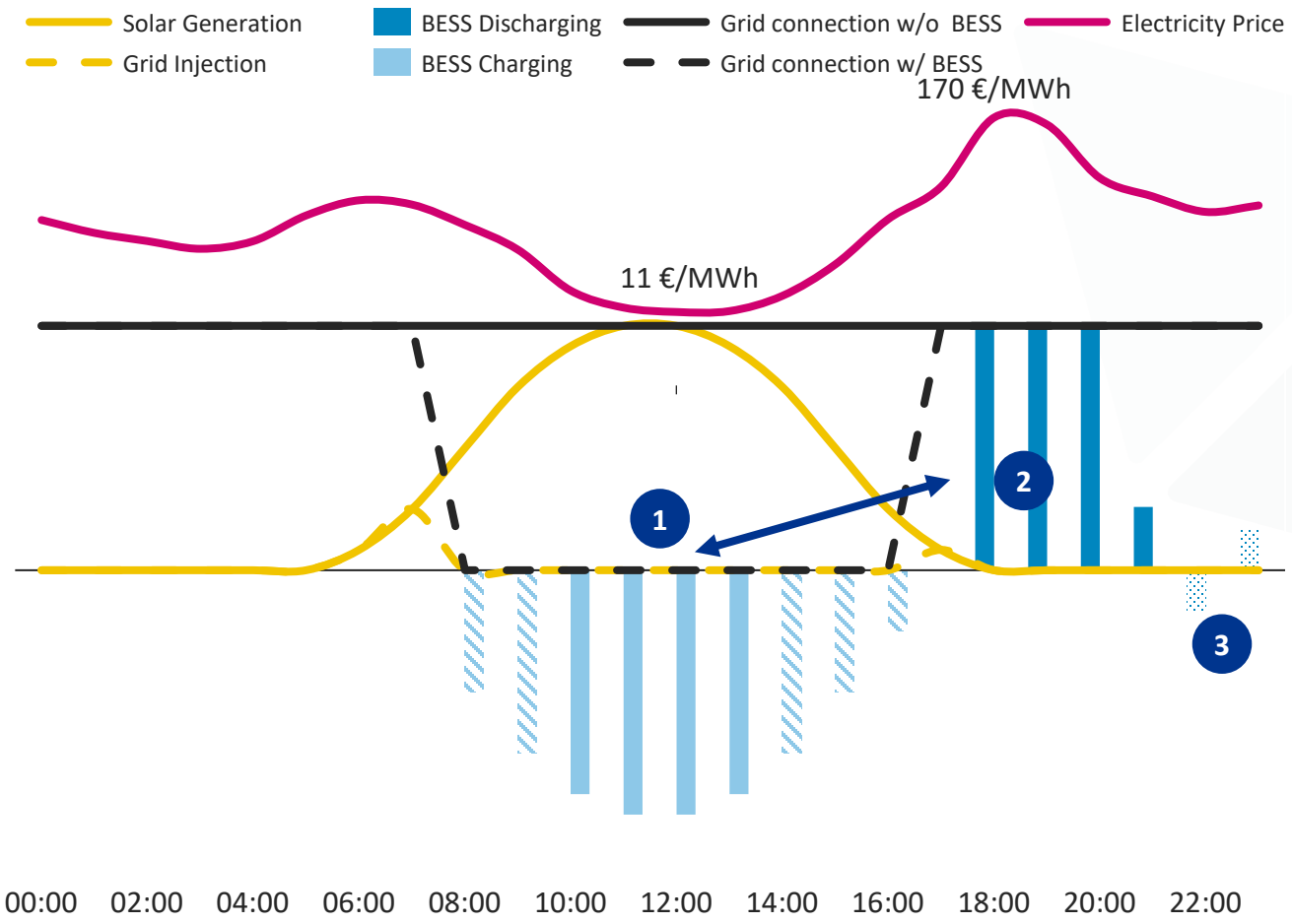
The battery is paid a top-up per MWh for this behaviour, but no night-time charging means it cannot always provide power in morning peak.

Critically, the restriction does not account for the real-time availability of the grid, and the asset is unable to participate fully in ancillary services markets.

These restrictions are being relaxed for future rounds.

Learning from abroad we should not fall into the same trap in the Netherlands – surely we can do better than a blanket restriction on feed-in!

Indicative operation of BESS for delayed feed-in



1. With a feed-in restriction we must either oversize the storage, or curtail volume. The support scheme must offset all these losses to make a viable business case.
   - This is a very roundabout way to pay for curtailment!
2. Asset is effectively doing wholesale arbitrage, but will be severely volume-limited.
3. We can still provide ancillary services or balancing during nighttime in both directions.

Critically, the restriction (again) does not account for the real-time availability of the grid.

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Time-varying grid tariffs improve the business case of co-located BESS due to the flexibility they can unlock, without necessarily restricting other revenue streams

Example from Dutch time-varying grid tariffs

	00:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
January	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.9	0.8
February	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.9	0.8
March	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1	1	1	1	0.9	0.8	0.8
April	0.7	0.7	0.6	0.6	0.6	0.6	0.7	0.8	0.8	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8
May	0.7	0.7	0.6	0.6	0.6	0.6	0.7	0.8	0.8	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8
June	0.7	0.7	0.6	0.6	0.6	0.6	0.7	0.8	0.8	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8
July	0.7	0.7	0.6	0.6	0.6	0.6	0.7	0.8	0.8	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8
August	0.7	0.7	0.6	0.6	0.6	0.6	0.7	0.8	0.8	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8
September	0.7	0.7	0.6	0.6	0.6	0.6	0.7	0.8	0.8	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8
October	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1	1	1	1	0.9	0.8	0.8
November	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1	1	1	1	0.9	0.8	0.8
December	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.9	0.8

A time-varying connection agreement allows you to arbitrage grid costs in addition to any market benefits

- Storage can arbitrage grid fees to which a baseload offtaker would be exposed.
- Under the new Dutch $kW_{max,\ gewogen}$ tariff we can reduce the peak evening offtake at cost of increased night/morning offtake.

If this sufficiently changes the profile of baseload offtakers, how often should we revise these weightings?

Restrictions from other commercial considerations can interfere with business-as-usual operation of a battery, but this can turn out to be pure revenue optimisation

Merchant (spot market)

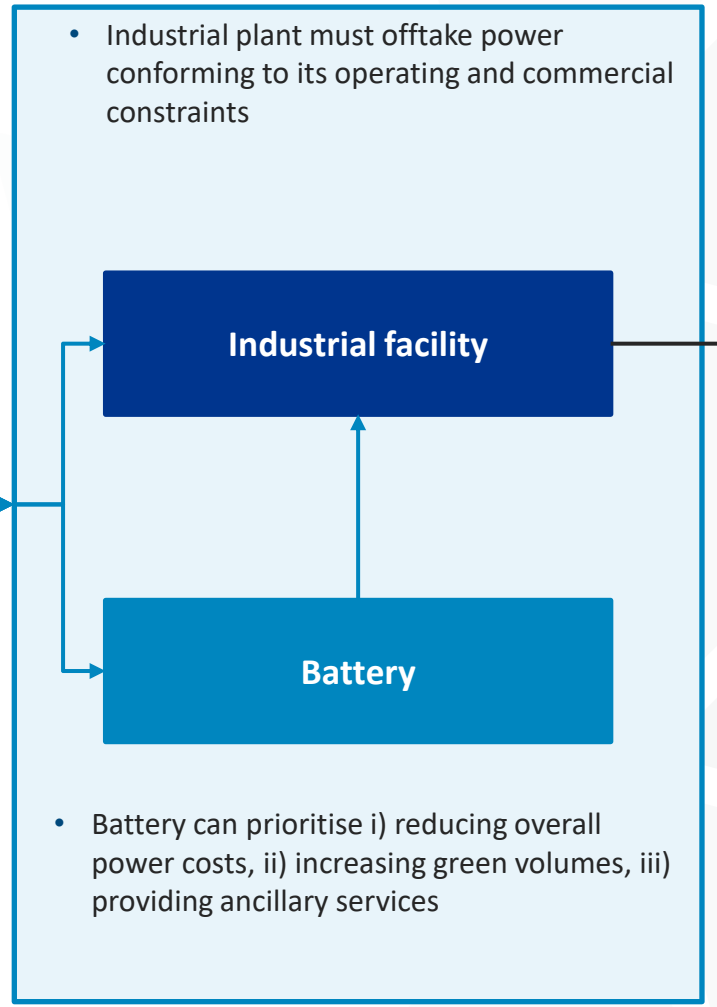
- Excess PPA volumes can be sold back to market.
- Green power volumes can be purchased from market.
- Non-green volumes can be purchased to avoid shutting down process.
- Battery can pursue arbitrage value.

RES PPA

- PPA guarantees green power.
- Price is fixed or floating.
- RES technology is not specified.

Ancillary services

- With remaining flexibility, BESS can provide grid services.



Delivered product

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Key lessons

A focus on efficiency requires us to look at all different forms of efficiency, to avoid inverse incentives

To create efficient incentive schemes…

…efficiently combining revenue streams across markets, systems, and regulations…..

…which support efficient deployment of investment capital….

…to connect and utilize as many MWs as possible

Baringa has the expertise to help you get there

We work across the full Energy Value Chain

- Generation & Investment
- Transmission & Distribution
- Smart assets & infrastructure
- Customers & Prosumers

A specialist Energy capability:

A diverse team of economic, operational, digital and industry experts

Transform to enable a decarbonised energy system and society

Transform network assets, access, management and operation

Mitigate physical and cyber risks and ensure system resilience

Deliver value to shareholders and customers enabling a just transition

Complemented by a range of specialists:

Specialist energy and cross-sector experience in the full range of capabilities

Policy and regulation	Market design and policy evaluation Regulatory strategy, cost assessment and incentive design
Commercial strategy	Totex and ODI optimisation Market views and advice M&A buy and sell side
Operations and Org Transformation	Transformation design and mobilisation Operational and process excellence Programme delivery and recovery
Supply Chain and Sustainability	Strategy and value optimisation Commercial excellence Sustainability and climate risk
Customer & Digital	Digital strategy and digital operating models Customer experience and journey design Industry solutions on market leading platform

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Baringa

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Rens provides commercial advisory around asset valuation, contracting structures, and market strategy for flexible and renewable assets. Based in Rotterdam, he supports clients across northwestern Europe to develop their commercial strategy, combining his background in research, trading, and consultancy to provide advice focused around value stacking of short-term markets. Developers, financers, and operators rely on his advice to build and evaluate business cases for financing, M&A activity, and contracting of batteries, electrolysers, and wind/solar farms.