TEAM ENERGY MANAGEMENT CONFERENCE, MILTON KEYNES 20TH NOVEMBER 2018

Distributed Generation Opportunities – Solar Power and Battery Storage

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Agenda

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Technology offerings

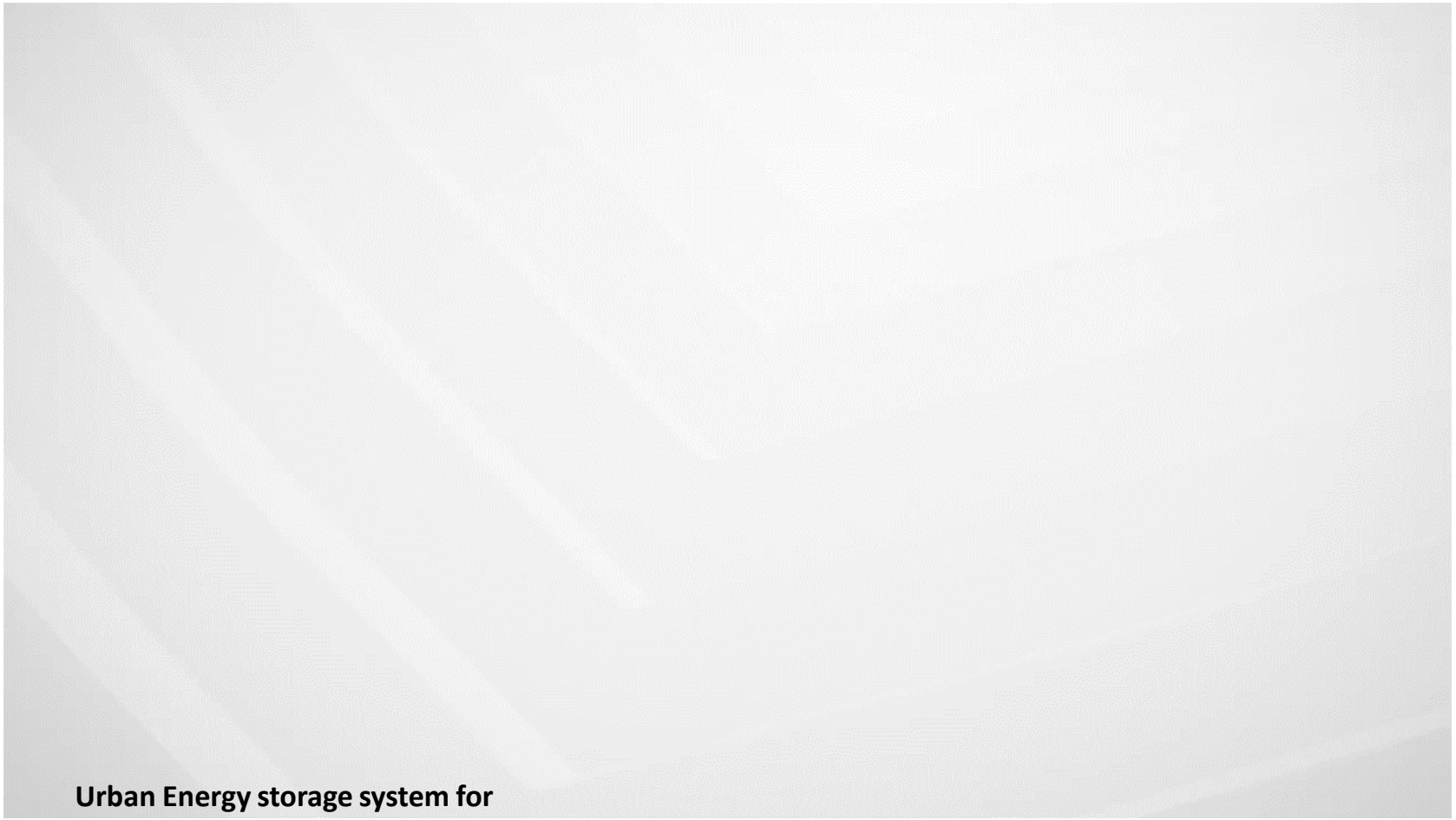
Developing a business case

Project References

Summary

Battery energy storage systems

Urban Energy Storage Project in Copenhagen



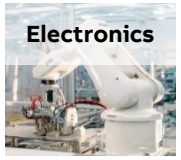
Urban Energy storage system for Copenhagen: https://youtu.be/YB-ncEUCY-U

ABB: a global pioneering technology leader

>130 years of history, >50% of offering today software based

What (Offering)	**Pioneering technology**		
	Products	Systems	Services & software
For whom (Customers)	**Utilities**	**Industry**	**Transport & Infrastructure**
Where (Geographies)	**Globally**		
	Asia, Middle East, Africa	Americas	Europe
	~$34 bn revenue (from 2017)	~100 countries	~147,000 employees





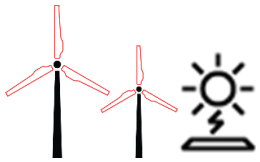
Challenges facing private and public sector entities

Impact of energy on operations cannot be ignored…

- **Poor power quality** e.g. low power factor attracting penalty charges from suppliers

- **Power outages** disrupt manufacturing and operational processes

- **Rising electricity bills** e.g. 40% of a non-domestic electricity bill is attributable to actual wholesale energy costs while 60% are network charges and levies



- Existing diesel, CHP, rooftop solar PV and other onsite renewable generation – how to **manage and optimize distributed energy sources** within a site or across sites: reduce electricity bills and keep the lights on?

- Increasing electric vehicle usage – how should large business premises prepare for such a future

- Regulatory drivers such as **DCP161** (*contracted energy*) and **MCPD** (*diesel gen*)

Battery Storage as a flexible energy solution

Value proposition – what will it do for you?

Energy efficiencies

Power Quality → improve low power factor, voltage balancing, harmonic mitigation

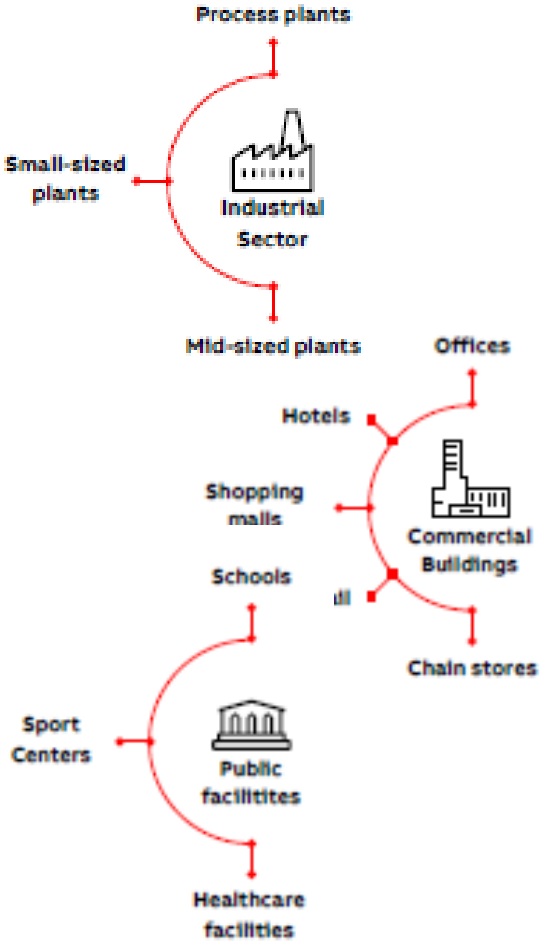
Cost Savings → through reduced electricity consumption from grid (*peak avoidance/self consumption)*

Energy Resilience (backup power)

Power outages → mitigate economic losses caused by disruption of manufacturing and operational processes

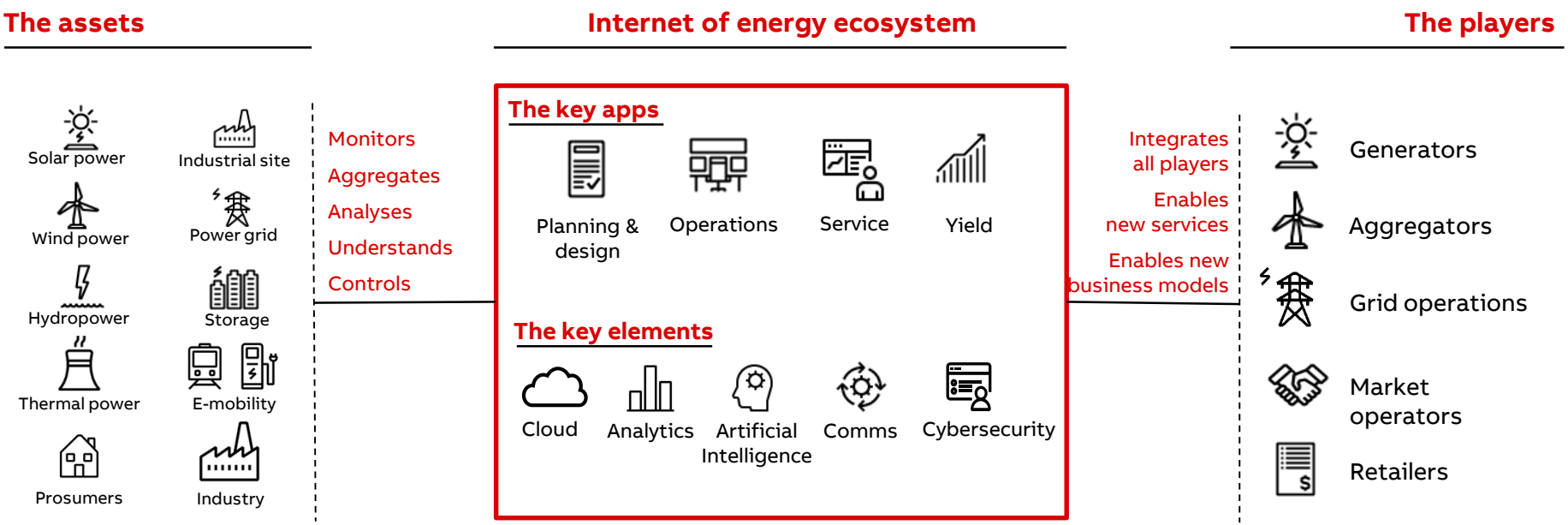
Additional Income Streams

Flexibility services → earn extra income/revenue streams through provision of demand side response, balancing mechanism services and energy arbitrage



Energy management in digital era

A digital ecosystem integrates players and their assets for supporting their business goals and processes



Battery Storage options

Product Portfolio and Applications for Behind the Meter market

Battery energy storage systems for C&I applications

Product Portfolio

Small systems - indoor

- Inverter
- Battery
- EMS (optional)
- Documentation
- Optional services
  - Factory acceptance test (only on PCS)
  - Site acceptance test (SAT)
  - Commissioning assistance
- Usually suitable for indoor installation
- **Power range: 10s of kW to few 100s kW**

Battery Rack

Control Cabinet (with ESI)

BESS product PQpluS

Value proposition

PQpluS offers:

- Compact (small footprint) design – less real estate needs where space is at premium
- Modular design – Easy to choose from a wide range of standard modules to suit individual application
- Built-in basic controller – all basic functionalities such as peak shaving, load leveling, back-up power etc. are integrated which needs minimal control interfacing at site
- Indoor or outdoor version – suits need of all type of customers. Outdoor version complete with HVAC
- Peace of mind – backed by proven technology and global support availability

REACT 2

Energy storage solutions

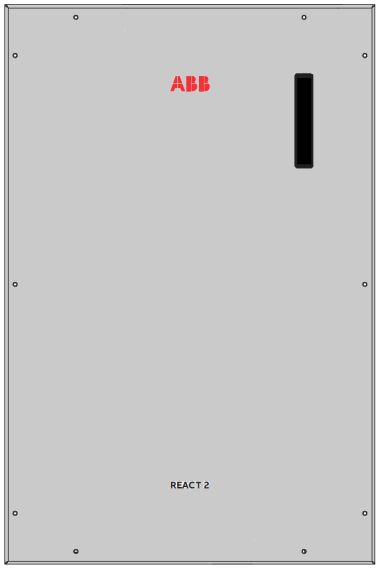
Shaping the next generation of smarter homes and small medium enterprises

- Easy and safe to install
- High energy self-reliance
- High energy efficiency
- Maximized flexibility
- High versatility
- Advanced Communication

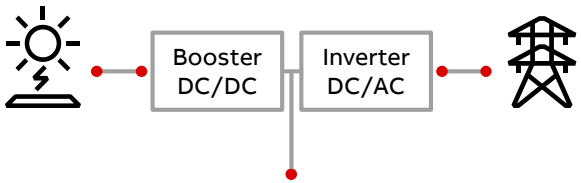
REACT 2

Inverter unit

Image



Schematic block



Values

	REACT2-3.6	REACT2-5.0
DC power	5 kW	6 kW
Grid conn. type	Single phase	
AC Power	3.6 kW	5 kW*
Backup	Yes	Yes
Env. Prot. rating	IP65	IP65
Marking	CE	CE
Isolation level	Transformer less	
Mounting system	Wall bracket	

*Limited to 4.6 kW where needed

Developing a business case

Four Pillars of a successful battery energy storage deployment

1. Deliver **Proven Technology**

2. Provide **lifecycle support**
   - install & commission
   - Service Level Agreements – repair, replace, exchange, recycle
   - from a local UK base

3. Develop **business case** with customer analysing their 1 year of Half Hourly energy usage
   - Partnerships with demand aggregators and energy suppliers

4. **Funding for projects** (avoid capex in non-core energy infrastructure projects and operational risk)
   - Leasing/hire purchase
   - Energy as a service agreements
   - 3rd party ownership of battery and customer receives reduced level of revenues and savings

Evaluating Half Hourly Load Profile Data

A water treatment plant in the UK with existing Wind Turbine and CHP generation

Months Nov 2017 – Feb 2018 analysed.

Average site HH import = 400kW

Max peak HH = 1193kW to 1825kW

Interestingly almost all the 48 HH peaks were hit during the period 27-Dec to 4-Jan with 2-Jan standing out in particular

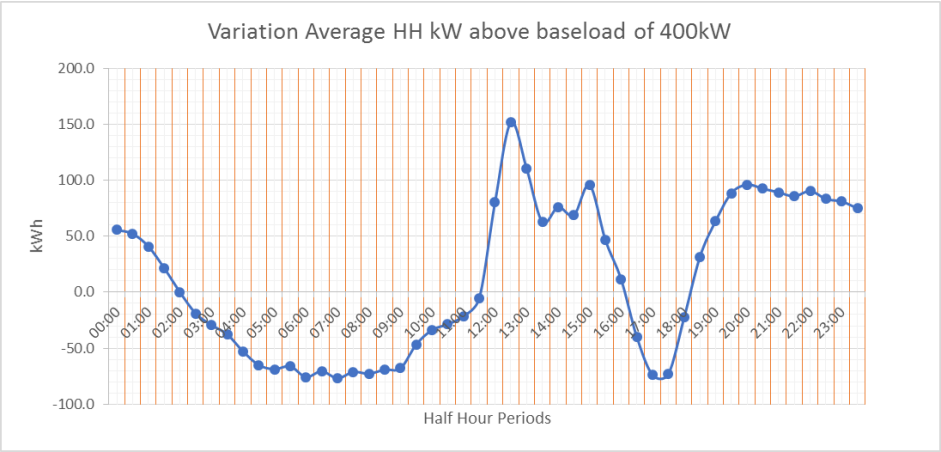
Generation data for 2-Jan reveals

- Wind generation = 30MW.
- CHP generation = 10MW
- Total consumption = 68MW
- Import = 58MW

Why was wind generation not used to offset the increased consumption?

- Wind generation exported to grid (no local consumption), CHP had maintenance work

Would Battery Storage have helped to store excess wind and offset the grid import?



Preliminary analysis reveals:

- Average daily profile shows that with base load set at 400kW for Nov 2017-Feb 2018, there is still significant variability in load profile.
- A Battery storage system could shave off the peak above 400kW occurring between 12:00 Noon – 4:30PM
- Battery could be charged at other times in the morning for e.g. from 02:00-12:00 or made available for DFFR

Use cases

Industrial and commercial sites

ICRC Logistics Center, PowerStore/PV/Diesel - Africa

About the Project

- **Project name:** ICRC Logistics Center
- **Location:** Nairobi, Kenya
- **Customer:** International Committee of the Red Cross

Solution

The resulting Microgrid system consists of:

- PowerStore Battery (150 kW/100kWh)
- Microgrid Plus Control System
- Solar PV (1 x 30 kW_p)
- Diesel (1 x 150 kW)

Customer Benefits

- Reliable and stable power supply
- Optimized renewable energy contribution
- Ability to island from the grid after an outage or faults
- Reduced diesel generator usage

ICRC

Press Release

The microgrid solution enables ICRC logistics center to deliver food and other essential like medicines, relief supplies across the African continent

Pilot operation Smart Farm - Germany

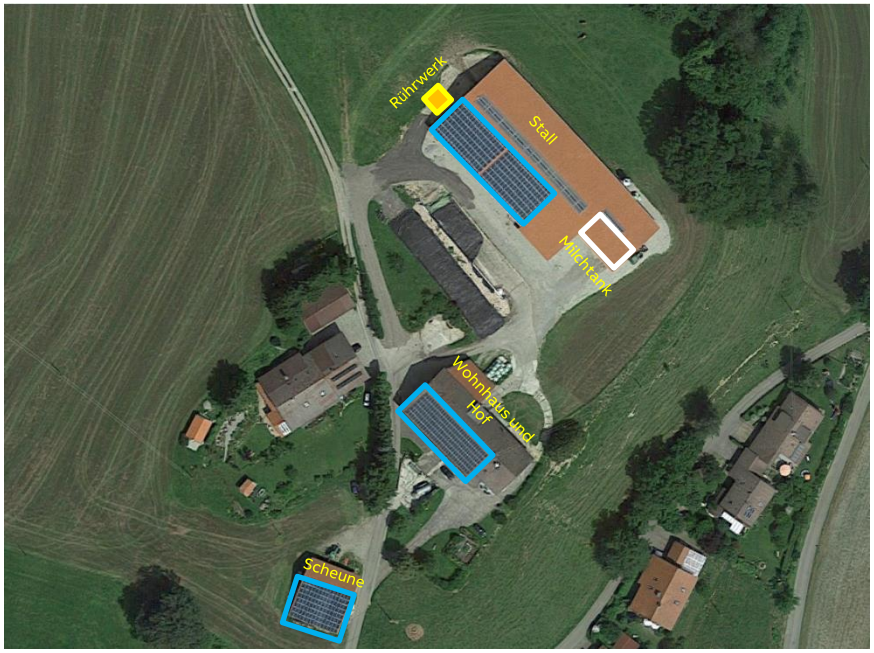
Modern organic farm with dairy cattle and advanced technology

Key data of the Smart Farm

- 3 PV systems with approx. 120 kWp, of which approx. 70 kWp for internal consumption
- Flexible consumers between 3 und 20 kW (Agitator, electric hot water tank)
- Battery storage 24 kWh / 20 kW
- Electric tractor approx. 36 kWh / 50 kW
- Grid connection with sufficient rated power

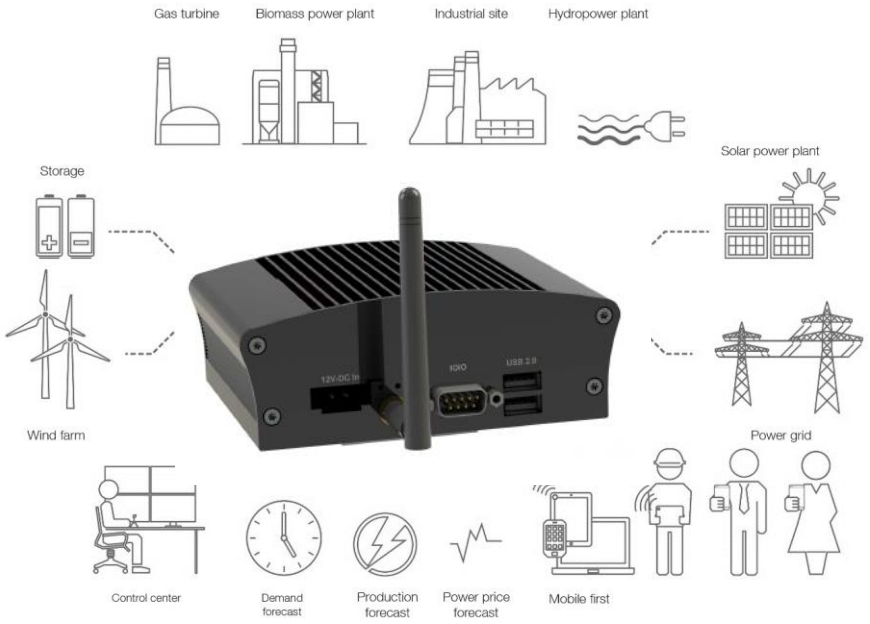
Aims

- Maximization of Internal power supply by using the existing flexibility
- Reduction of load peaks
- Merger of several companies to participate in the trade

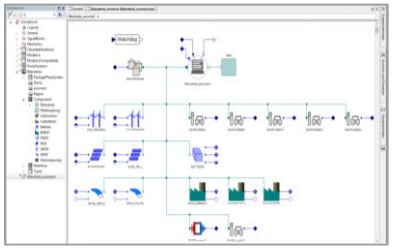


Technology for Day-Ahead and Real-time optimization

Embedded Hardware at site (industrial PC or similar)



Models for application engineering



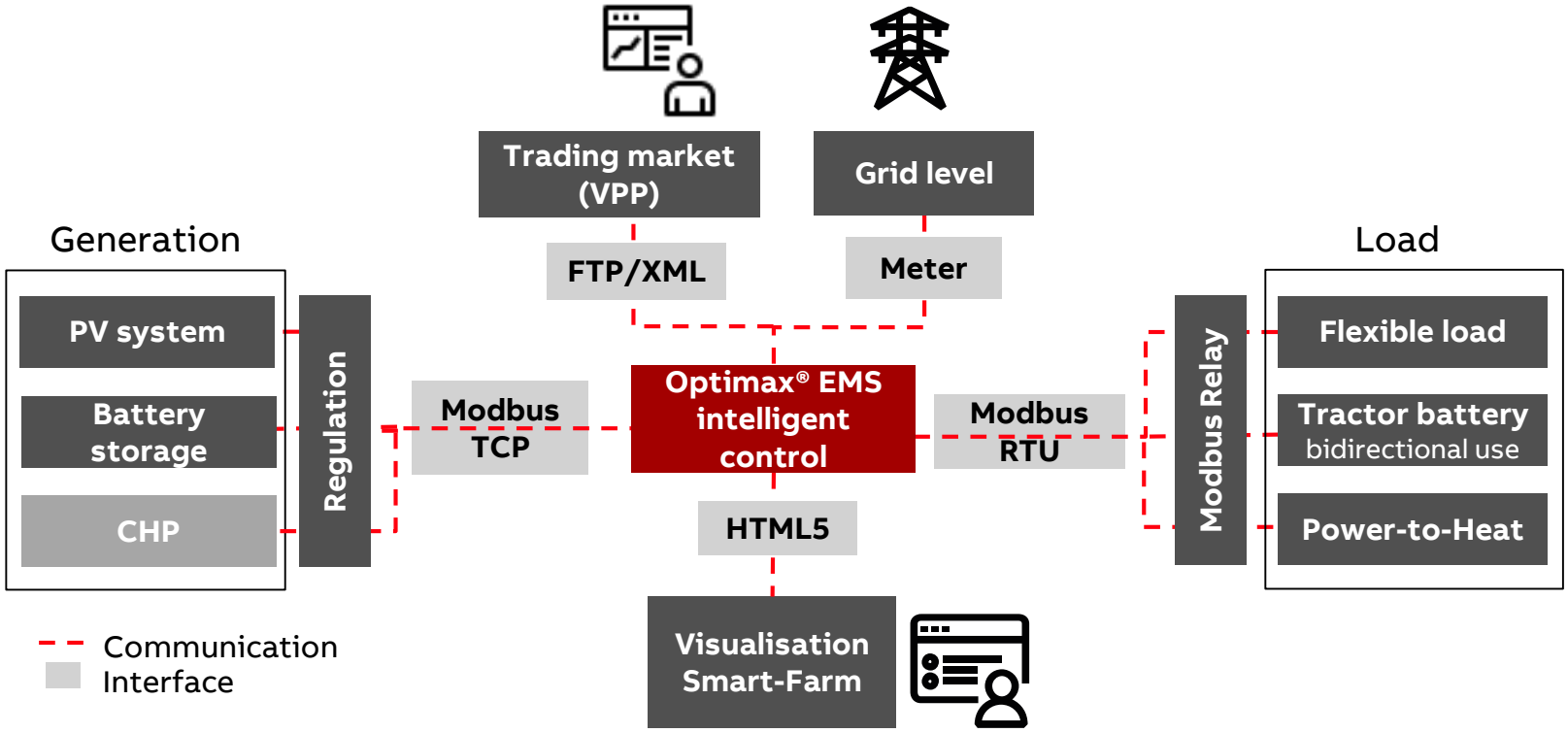
FMI (Functional Model Interface) for deployment

Embedded

Server

Cloud

System integration of the EMS



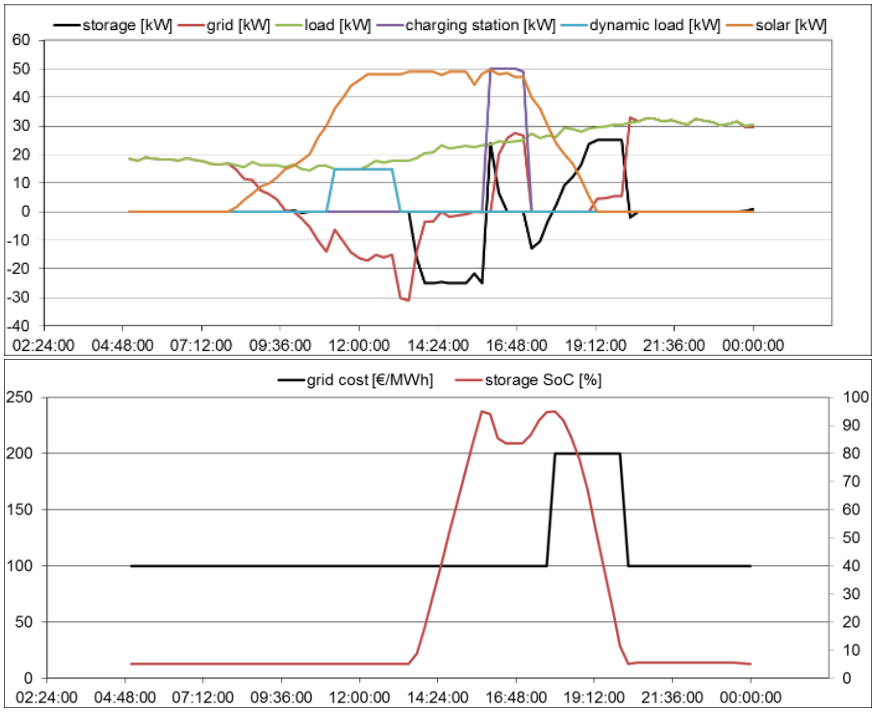
Optimization results

Results for one day

Explanation:

- PV forecast from weather prognoses, load forecast from historical data
- Agitator must run daily for at least 2 hours at a time
- Standing time of the tractor is scheduled and it can be shifted in the frame
- Battery storage is freely optimized
- Grid costs in the evening at peak load are more expensive

Smart farm power flow



variable grid costs and battery state of charge (SoC)

A 1MW/1MWh Revenue Illustration

1. Capital Expenditure = £600,000 (estimated)

2. Annual Savings + Revenue = £91,445 (conservative)

3. Revenue from frequency response:

Gross frequency response payment = £55,900

4. Savings from energy bills:

Triad avoidance = £30,800

DUoS/GDUos/CM Levy Avoidance = £5,800

Gross Capacity obligation payment = £15,600

5. Deductions:

Battery Charging Costs & Service Fee for DSR provider = £16,655

** Modelling undertaken shows energy cost, operational revenues and cost avoidance only. It does not show operation & maintenance costs.*

- Payback period = £600,000 / £91,445 = **6.56 years** (simplified and does not include any leasing arrangements).
- 5 years payback is achievable if participation in frequency response market is sooner.
- **Shorter payback periods** can be explored through combination of various funding models (ESCO, Storage as a Service, Hire Purchase, etc.) which can be tailored to suit actual business case

Summary

Summary

Energy storage challenges and opportunities

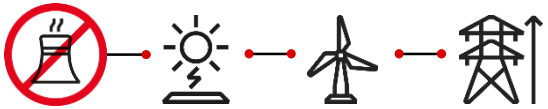
UK Challenges

The UK's electricity demand is often higher than its generation capacity.

£1500 MWh

The cost is expected to remain both high and volatile. On several occasions, this situation has pushed the price of electricity to a record breaking £1500/MWh, 30x the normal price.

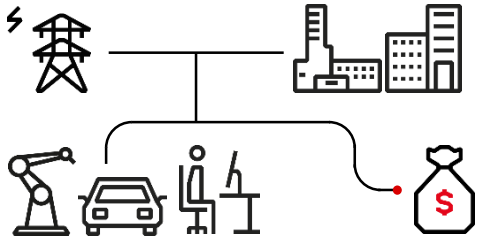
As energy networks get decarbonized, fewer conventional generation plants are getting built. Renewable energy is replacing them but this adds to the variability causing price increases.



Challenges for industrial businesses

40% of a non-domestic electricity bill is attributable to actual wholesale energy costs. Network charges account for the rest.

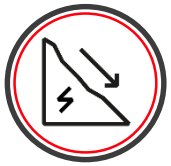
40%



How can businesses manage and optimize distributed energy sources within a site or across sites: reduce energy costs and keep the lights on?

ABB's solutions

Energy storage enables users to "time-shift" their use of energy and avoid peak tariff periods.



ABB's energy storage technology is based on its advanced power conversion technology which is optimized to support power quality of the electricity network and enable access to energy markets, ancillary services and energy savings.

Reach out to us for your flexible and distributed energy solution

Energy transformation will be led from behind the meter…