

Status: Q1 2021 Information subject to change without notice.



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Global VRFB Leader with 130+ projects & 5Mio+ operating hours >50% of all globally installed

















































CellCube sets the highest standard in VRFB's

20year+ experience sets market leading standards – Austria based European Leader in long duration energy storage



CellCube European market leader in VRFB's

International business track record of Enerox (incl. Gildemeister)



MaxTarget 200 Plan Remote

ENERGY (kWh)

88%

Daily Monitored



Deployed in regions from -40° to +50° Celsius

www.cellcube.com

partner for energy storage infrastructure services

Overview of Service Options & Project Partner Logos





SOLUTION DESIGN

Fit for Purpose Analysis Modelling & System Simulation Integrating Renewables & Power Systems Research & Development / Customized Solutions

TURNKEY SOLUTION

Containerized DC/AC Storage System – PCS selection optional Integrated Battery Management System (BMS) – EMS optional Standardized communication interfaces Installation, Integration and commissioning services Balance of Plant (optional)



OPERATION & MAINTENANCE SERVICES

Basic System Maintenance

Extended system warranty

Monitoring & lifetime services

Performance Guarantees



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New Electrification

Annual Installed Long Duration Storage Energy Capacity and Deployment Revenue by Region, All Applicable Technologies, Durations, and Applications: 2018-2027

More PV & Wind are

getting deployed

Global renewable electricity generation is projected to grow by almost 45%, or 2,245 TWh to over 7,310 TWh in 2020

Source: Navigant Research, Bloomberg Energy, CellCube

Power & Grid Flexibility

Forget Lithium – we need green & energy centric storage...

Requirements & Results from Market Research for stationary storage in 2018/2019

large renewable power generation with smooth infeed at lowest cost

2 – 4 hour peaking power both for reserve & capacity markets

flexible operation of microgrids / areal networks

More Peaking & Reserve

Renewable Integration

Capacity Markets Capacity is required Increasing RE integration challenges conventional

peaking reserve.

Renewable Baseload can provide Must-Run-Rate

De-Carbonization

Less & replacement of Diesel / Gas off-grid

Energy Demand in remote areas grows significantly.

Demand for conventional gensets drops at same time to be replaced by PV & Wind plus storage

Smart Cities & Communities

More micro-grids and smart infrastructure needed

Increase of distributed generation and e-mobility drives demand for local flexibility.

Annual distribution revenue expected to reach nearly US \$20 billion by 2023



cellci ihe BUILDING ENERGY STORAGE INFRASTRUCTURE

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Flow Batteries show best fit for stationary energy storage

requirements Comparison of key storage technologies for energy centric (long duration) stationary storage BUILDING ENERGY STORAGE INFRASTRUCTURE

Flow Batteries are more cost efficient on price / kWh for long duration storage than Lithium...



Source: Navigant Research: Utility-Scale Energy Storage System, Installed Cost CAPEX Assumptions, Long Duration Technologies, World Averages: 2018-2027

... and Hydrogen is not yet ready and cost efficient for large scale deployments

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Hydrogen (\$/kWh)



Source: Lazard Levelized Cost of Storage Report #4 – 4 hour duration

CellCube's product roadmap includes forward costs of below 100USD/kWh

CellCube's solutions focus is on reduction of LCOE and TCO



CellCube solution & use case overview for selected market segments

Co-Location Large Renewables

- Large Scale / Green PPA's
- Renewable Integration
- Renewable Baseload

C&I / Microgrid

- Resilience / UPS
- Bill Optimization
- Community & Industrial Zones
- Remote Sites / Offgrid



Capacity & Reserve Markets

- Green Peaker Plants
- Heavy Duty Cycling for Industrial Plants
- Grid Constraint Management
- Ancilliary Services

experience the new generation of flow batteries





safe. flexible. more power. highest efficiency.

Power and Storage – scalable, available, flexible and safe



CellCube Product Families



Typical layout 2MW/8MWh with central PCS concept



Storage – Technical drafts



CellCube sets the highest standard in V-Flow Batteries

The ENEROX experience sets market leading standards - joining the CellCube Family in 2018 BUILDING ENERGY STORAGE INFRASTRUCTURE



96% / 98%

Reduced Costs on CAPEX / OPEX

Performance Guarantees on Power / Capacity over 20 years**

* 200% overrating for discharge available in 2020, currently 150%* released / **Annual O&M services required

Overrating allows increased revenues at reduced costs



Storage – overrating feature





- Charging at 200% nominal power allows to
- ✓ Max out solar feed-in throuhgout the day
- ✓ Max out cheap night-tarifs to reduce charging costs
- ✓ Increase number of cycles per day
- ✓ Get storage system much quicker ready for next use

Dis-charging at 150-200% nominal power allows to

- Keep performance obligations in range e.g. discharge
 100% within contracted range
- Gain double revenues in power-related market schemes e.g. PFR, FFR, PJM, FCAS
- Mulicycling of battery (4-10 cycles (1C) per day) without degradation

O&M Strategy supporting bankable Performance Guarantee Celicube



Munich RE 葦

CellCube O&M Scope and Services



Project: Simris, Sweden – Local Distribution Grid

CellCube Case Study – part of Interflex H2020

In cooperation with e.on HQ and e.on Sweden CellCube is part of the first innovative microgrid energy system in Sweden using 100% locally produced green energy for a community with 150 households.

Combining a Photovoltaic park, a 660kW wind turbine, some residential solar and lithium storage and the CellCube energy storage system a stable green energy supply for 600 people of the nearby villages has been achieved. The quick reacting EMS from e.on measures and controls voltage and frequency of the entire network to ensure grid stability for a reliable power supply. The 4hour CellCube energy storage system provides with its fast response PCS feeds the local grid with precise reactions, from milliseconds to hours.

CellCube has delivered a turn-key solution incl. electrolyte leasing and O&M support including DC hardware, Vanadium-based electrolyte, BMS, PCS on LV level and installation service.

See more: <u>https://www.eon.se/en_US/om-e-on/local-energy-systems/we-are-renewing-simris.html</u>, <u>https://interflex-h2020.com/interflex/project-demonstrators/sweden-simris/</u>



250 kW 1000 kWh

Rated AC power & capacity 2nd Quarter 2019

Installation date

Microgrid, Renewable Integration

eon

DSM, frequency regulation, Offgrid, renewable baseload, energy shifting Key Applications



Project: Karlsruhe, Germany – Local Microgrid,

CellCube Case Study

As part of the Energy Lab 2.0 project of the Karlsruher Institute for Technology (KIT) we delivered the core-element for long duration energy shifting's. The CellCube energy storage system as energy-centric link in a realistic microgrid research project.

The purpose of this project is to examine the interaction of high fluctuating renewable energy resources with two main storage technologies, Lithium-Ion and Vanadium Redox Flow. The KIT developed a new control system with an optimized software to achieve a cost efficient and technical best large scale energy storage solution. This results in a hybrid storage solution combining the sweet spots of the technologies, namely fast frequency response done by Lithium-Ion and supply of high amounts of energy by the CellCube energy storage system for this application. In times of high yields from the PV and wind generation the CellCube energy storage system stores the long duration surplus.

CellCube provided the KIT with a turn-key energy storage solution including DC hardware, Vanadium-based electrolyte, BMS, PCS on LV level and installation service.

See more: <u>https://www.batterietechnikum.kit.edu/817.php</u>





200 kW 800 kWh

Rated AC power & capacity

1st Quarter 2019

Installation date

Microgrid, Renewable Integration

Market sector

Energy Shifting, Hybridization, VR, PQ

Key Applications



Project: Gelsenkirchen, Germany – Renewable Energy Park

CellCube Case Study

Gelsenwasser AG in cooperation with the University of Applied Sciences Münster are operating a plant with a generation mix of PV, wind and biomass to full autonomous green energy supply for a whole village with about 7200 citizens.

All sources combined result in a 29 MWpeak output what is, at least calculated, enough to power all those households. In practice the fluctuating sources make it unpredictable and far to unstable for a baseload supply what makes the use of energy storage systems necessary. For that reason the University is testing various technologies like gas, heat or electrochemical and will chose the most efficient for the large scale realization. The CellCube energy storage system was installed to simulate the part as a long term storage solution to shift surplus energy into night hours or hours with less production. An important aspect in this project is also the focus on highest safety which makes CellCube the ideal partner with its 100% safety record thanks to system design, the non-flammable and non-explosive Vanadium-based energy carrier. CellCube installed a down scaled turn-key energy storage solution including DC hardware, Vanadium-based electrolyte, BMS and PCS on LV level. See more: http://energiespeicher.nrw/redox-flow-batteriecellcube-fb-15-130/



GELSENWASSER

15 kW 130 kWh

Rated AC power & capacity

2nd Quarter 2018

Installation date

Microgrid, Renewable Integration

Market sector

Microgrid, Energy Shifting

Key Applicationse



Our value proposition puts our clients into a leading position \square

CellCube Product & Solution Highlights



 Commercially viable solutions for long duration storage systems for 2 - 12 or more hours of energy storage

BUILDING ENERGY STORAGE INFRASTRUCTURE

- Overrating up to 200% to allow increased revenues at lower cost
- No capacity degradation and multi-cycling per day
- ✓ 100% usable depth of discharge (DoD)
- Extended service life of more than 20 years
- ✓ Safe, non-flammable, non-explosive, environmentally friendly
- ✓ Finance Solution with bankable assets and rental option
- Products in the field running over 10 years
- CellCube tested with more than 10,000 uninterrupted cycles

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Thank you very much for your attention!

ENEROX GmbH

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