Use your own power grid.

Intelligent storage systems based on vanadium redox flow technology.

www.cellcubeenergystorage.com
CellCube. The storage system for intelligent power supply.

The CellCube energy storage system is a milestone in the history of regenerative energy management. Whether in combination with photovoltaic, wind power stations, biogas generators or in parallel grid operation – the vanadium redox flow energy storage system guarantees uninterrupted power supply. It is independent of weather conditions, temperatures, or grid instability.

With well thought through and mature products, from generation up to storage and provision with the energy storage system, CellCube offers holistic systems for the modern energy industry. Our solutions represent maximum energy yield, simultaneously being environmentally friendly. The CellCube energy storage system, which was tested and proven in practice for over five years, solves the problem of energy storage. It presents uninterrupted supply of power from solar and wind power stations, also during periods of darkness or without wind. Therefore CellCube is the missing link for supporting the development of renewable energy.

The CellCube energy storage system provides clean and emission free power within milliseconds. It distinguishes itself through absolute safety, a proven track record of reliability and the longest operation life. The system can be incorporated into existing power infrastructure in numerous application fields whilst incorporating new renewable energy sources. Sophisticated technology, proven components, intelligent sensors and control functions ensure that the CellCube is the most reliable solution with the lowest maintenance. The flow energy storage system controller is a clever instrument that provides remote monitoring and comprehensive control to guarantee safe provision of power 24/7 year round.
Modular and flexible for every situation

CellCube, the individual energy storage system adapts to every requirement. The system power output and capacity is scalable from the kilowatt range to the megawatt range without a problem.

The modular and flexible structure of the system allows varied application options - conceptualised according to requirements, depending on customer preferences and requirements.

CellCube history

- 1999 Research and development
- 2004 First field trials
- 2008 Market launch FB 10-100
- 2010 GILDEMEISTER participation
- 2011 Market launch FB 200-400
- 2018 CellCube Purchases GILDEMEISTER assets
CellCube - for a stable power supply.

The low-maintenance redox flow energy storage system based on vanadium, guarantees uninterrupted power supply, fed by solar or wind power stations, for instance. In its weather-proof housing the CellCube can be used immediately worldwide. Clean power 24/7 year round.

Highlights CellCube

- High safety, non-flammable, non-explosive
- Practically unlimited cycling with no degradation over time
- Scalable to the MW-range through simple parallel connection of multiple CellCubes
- 100 % depth of discharge capable
- Turnkey energy storage self-contained in weatherproof and securely protected housing
- Up to 80 % efficiency
- Holistic system solution, including specially coordinated inverters, allowing connection to different energy sources
- Remote or online maintenance
- Central temperature management, climate controlled
- Optimal operational characteristics through intelligent battery management
- Standard freight containers allow simple and cost-effective transport
- Vanadium is environmentally friendly and recyclable
- Spontaneous reaction to load demand
CellCube - for individual applications.

The CellCube redox flow is the perfect solution for industrial applications. With capacities of 400, 800 and 1,600 kWh and discharge power output of 200 kW, CellCube offers huge energy reserves for power failures or to cover peak demand.

CellCube application fields

- **Grid support**: For the stabilisation of low voltage and medium voltage grids; as energy reserve; for smoothing out peaks (compensation of load and generation peaks)
- **Backup**: Use as inline UPS with frequency and amplitude decoupling; leading edge system safety
- **Wind and solar parks**: As buffer to smooth energy output and to compensate for fluctuations; higher contract security due to energy reserves in times of reduced power
- **Re-powering**: Investment protection - CellCube ensures constant supply, even after amortisation of the wind or solar park
CellCube - The modular solution for every application.

Flexible, modular and individually applicable - that is CellCube, the redox flow energy storage system based on vanadium. The modules of the individual CellCube families can be combined simply and quickly, depending on the requirement. This is the basis for a flexible, tailor-made implementation and a wide range of power output from the kilowatt range to the megawatt range.

Available power and storage capacity

<table>
<thead>
<tr>
<th>Power output (kW)</th>
<th>Storage capacity (kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CellCube FB 10</td>
<td>10  40  70  100  130</td>
</tr>
<tr>
<td>CellCube FB 20</td>
<td>20  40  70  100  130</td>
</tr>
<tr>
<td>CellCube FB 30</td>
<td>30  40  70  100  130</td>
</tr>
<tr>
<td>CellCube FB 200</td>
<td>200 400 800 1600</td>
</tr>
</tbody>
</table>

CellCube - combination examples

- **FB 10-100**
  - 10 kW, 100 kWh
- **FB 200-400**
  - 200 kW, 400 kWh
- **FB 400-800**
  - 400 kW, 800 kWh
- **2x FB 10-100**
  - 20 kW, 200 kWh
- **FB 200-800**
  - 200 kW, 800 kWh

A solution for every requirement *

<table>
<thead>
<tr>
<th>Power (kW)</th>
<th>1 h</th>
<th>2 h</th>
<th>3 h</th>
<th>4 h</th>
<th>5 h</th>
<th>6 h</th>
<th>8 h</th>
<th>10 h</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>FB 10-40</td>
<td>FB 10-40</td>
<td>FB 10-40</td>
<td>FB 10-70</td>
<td>FB 10-70</td>
<td>FB 10-100</td>
<td>FB 10-100</td>
<td>FB 10-130</td>
</tr>
<tr>
<td>20</td>
<td>FB 20-40</td>
<td>FB 20-70</td>
<td>FB 20-70</td>
<td>FB 20-100</td>
<td>FB 20-130</td>
<td>FB 200-400</td>
<td>FB 200-400</td>
<td>FB 200-400</td>
</tr>
<tr>
<td>30</td>
<td>FB 30-40</td>
<td>FB 20-70</td>
<td>FB 30-100</td>
<td>FB 30-130</td>
<td>FB 200-400</td>
<td>FB 200-400</td>
<td>FB 200-800</td>
<td>FB 200-800</td>
</tr>
<tr>
<td>100</td>
<td>FB 200-400</td>
<td>FB 200-400</td>
<td>FB 10-40</td>
<td>FB 200-800</td>
<td>FB 200-800</td>
<td>FB 200-800</td>
<td>FB 200-1600</td>
<td>FB 200-1600</td>
</tr>
<tr>
<td>150</td>
<td>FB 200-400</td>
<td>FB 200-400</td>
<td>FB 200-800</td>
<td>FB 200-1600</td>
<td>FB 200-1600</td>
<td>FB 200-1600</td>
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<td>FB 200-1600</td>
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<tr>
<td>200</td>
<td>FB 200-400</td>
<td>FB 200-800</td>
<td>FB 200-800</td>
<td>FB 200-1600</td>
<td>FB 200-1600</td>
<td>FB 200-1600</td>
<td>FB 200-1600</td>
<td>FB 200-1600</td>
</tr>
</tbody>
</table>

* The optimal combination of power and energy capacity are specified in each case (other combinations or oversizing are also possible)
# Technical data.

<table>
<thead>
<tr>
<th>Performance and energy</th>
<th>CellCube FB 10/20/30 kW</th>
<th>CellCube FB 200 kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal charge output</td>
<td>10/20/30 kW</td>
<td>200 kW</td>
</tr>
<tr>
<td>Nominal discharge output</td>
<td>10/20/30 kW</td>
<td>200 kW</td>
</tr>
<tr>
<td>Capacity of the energy storage system</td>
<td>40/70/100/130 kWh</td>
<td>400/800/1600 kWh</td>
</tr>
</tbody>
</table>

**Battery and system voltage**

<table>
<thead>
<tr>
<th>Output voltage option</th>
<th>CellCube FB 10/20/30 kW</th>
<th>CellCube FB 200 kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-independent: 48 VDC, 120 VAC, 230 VAC (1-phase); 400 VAC (3-phase)</td>
<td>400 VAC</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration of connection/Reaction time</th>
<th>CellCube FB 10/20/30 kW</th>
<th>CellCube FB 200 kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-independent: &lt; 20 ms, remote converter: &lt; 3 ms</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Control system**

- Control via external interfaces: serial, TCP/IP, bus systems

**Monitoring**

- Condition detection via remote monitoring by e-mail: State of charge (SOC), available energy, charge/discharge power output, and more

**Efficiency**

- Charge/discharge cycle DC: up to 80% (CellCube FB 10/20/30 kW), up to 80% (CellCube FB 200 kW)
- Multi-stage management reduces power losses: 3 independent, switchable circuits with energy-efficient pump control system (CellCube FB 10/20/30 kW), 4 independent, switchable circuits with energy-efficient pump control system (CellCube FB 200 kW)

**Self-discharge**

- Self-discharge in standby: < 150 W (CellCube FB 10/20/30 kW), < 200 W (CellCube FB 200 kW)
- Self-discharge in tank: negligible (< 1% per year) (CellCube FB 10/20/30 kW), negligible (< 1% per year) (CellCube FB 200 kW)

**Size and weight**

<table>
<thead>
<tr>
<th>Dimensions L x W x H</th>
<th>CellCube FB 10/20/30 kW</th>
<th>CellCube FB 200 kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>4,660 x 2,200 x 2,420 mm (15 x 7 x 8 ft)</td>
<td>4,060 x 2,440 x 5,800 mm* (20 x 8 x 19 ft)</td>
<td></td>
</tr>
</tbody>
</table>

- Weight (empty condition): 3.8 - 4.5 t (CellCube FB 10/20/30 kW), 20 t (CellCube FB 200 kW)
- Gross weight (filled condition): 7 - 14 t (CellCube FB 10/20/30 kW), 60 t (CellCube FB 200 kW)

**Climatic operating conditions**

- Climatic control: -40°C to +50°C (monthly average temperature)
- The inside temperature is controlled between 20°C and 30°C by an intelligent temperature management system. Suitable insulation (for heating and cooling) allows deployment in any climate.

* Base unit. ** Subject to change.
Advantages of the vanadium redox flow battery

- Almost unlimited service life of the energy sources; system is designed for up to 20 years
- Unlimited cycles (charging/discharging) at the energy storage unit
- 100% deep discharge
- High safety - non-flammable and non-explosive
- Low maintenance
- Power output and energy can be scaled independently of each other (modular flexibility)
- Scalable up into the MW-range through simple parallel connection of multiple CellCubes
- Self-discharge is negligible
- Only one battery element - therefore no cross-contamination
- Homogeneous energy medium
- Vanadium is a widespread raw material
Vanadium redox flow is the most sustainable and durable energy storage technology available today. The vanadium storage system exclusively uses fluid energy sources with dissolved vanadium salts. They are not subject to cycle degradation and can be used without limitation. Conventional batteries are subject to wear and tear through loss of reactive materials. Vanadium flow energy storage systems do not contain any deleterious materials such as lead, cadmium or mercury and are neither flammable nor explosive.
Optimal power for your system

Stacks & electrolyte tank: A stack is a number of serially connected cells, with electrolyte from both tanks flowing through them. The battery is then charged and discharged via these cell stacks. The more stacks in a battery, the higher the power output. Separated storage of electrolytes in two tanks offers significant advantages for energy storage: The larger the electrolyte tanks the greater the energy storage capacity.

- The electro-chemical process, which charges or discharges the battery, takes place in the cell stacks.
- The electrolyte is pumped from the electrolyte tanks to the stacks by chemical-proof pumps and then flows back to the same tanks via return lines.

Highlights: Stacks

- Modular flexibility: more stacks, higher power output
- Simple maintenance
- Tested for 100% leakproof performance
- Simple and exchangeable membranes

Integrated energy management system

Absolute safety and reliability is provided by sophisticated design and technology: double-wall tanks, intelligent sensors and control functions, comprehensive monitoring procedures and simplified maintenance. The flow battery management system ensures comprehensive control around the clock, so that all battery information can be monitored online anytime. In addition, CellCube offers tailor-made services and maintenance contracts for a reliable supply of power for the system life.

Service function monitoring: All important operational parameters can be interrogated online at any time, for instance state of charge (SOC), electrolyte temperature or charging power. An optional monitoring touch display can be attached to the battery at an extra charge.
CellCube. The short cut to a storage system

Quick provision of energy has been a decisive criterion for the CellCube energy storage system right from the start. Transport to the installation site is as simple as the installation itself. The storage system for intelligent power supply has taken simplicity as its role model.

**TRANSPORT**
Quick supply to the installation site through the use of standard container sizes.

**INSTALLATION**
Multiple CellCube units can easily be combined and are ready for operation immediately.

**COMBINATION**
The energy storage capacity is extended into the MW-range with every additional CellCube unit.

**APPLICATION**
The CellCube energy storage system is ready for operation in all climatic and weather conditions.
Industrial solutions

Individual solutions for companies that generate their power requirements and use it themselves.

Power solutions

As a buffer to smooth the power output and to compensate for fluctuations.

E-mobility solutions

Problem-free storage or renewable energy for the operation of e-vehicles and solar filling stations around the clock.

Tele solutions

Reliable storage of energy and power supply for telecommunication networks in regions without a stable power grid.

Off-grid solutions

A low-maintenance energy storage system for buildings without connection to a power grid.
Energy-efficient complete solutions.

Save energy
CellCube Energy Storage Systems Inc. represents necessary and comprehensive awareness of energy, focusing on intelligent generation, storage and use of energy. It all starts with an energy efficiency analysis.

Utilize energy
Intelligent products and technologies for modern industry:
- E-mobility solutions
- Industrial solutions
- Backup solutions
- Off-grid solutions
- Tele solutions
- Power solutions

Store energy
CellCube: The vanadium-based energy storage system with a long service life offers interruption-free supply of power. It is available with power ratings from 10 to 200 kW and a scalable capacity up into the MWh range. In this way base load coverage, power peak limiting and safeguarding of sensitive areas can be guaranteed at all times.

Energy efficiency in industry
DECKEL MAHO Seebach, Germany
Energy solutions Park, Bielefeld, Germany