

Intelligent Energy Storage

The world's most advanced vanadium redox flow system.

green
energy

Long duration,
> 20 year life, low maintenance
modular, proven & reliable,
turn-key solution




AMERICAN VANADIUM
in partnership with
GILDEMEISTER
energy solutions

COMMERCIALY
AVAILABLE
NOW

CellCube. The 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, biogas or in parallel with the grid - the vanadium redox flow energy storage system guarantees uninterrupted power supply. System performance is reliable and independent of weather conditions, temperatures or grid instability.

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.

American Vanadium CellCube is now in full scale production with over 50 systems commercially installed globally. Designed and fabricated to German engineering standards by Gildemeister, the CellCube is a proven, reliable and safe energy storage solution with over five years of field testing.

With unlimited deep cycling over a >20 year system life, low maintenance cost and modularity of separate power and energy units, the CellCube provides amongst the lowest Levelized Cost of Energy. An additional key feature includes being weather proof and operational in all climates without the need for a building. This plug and play system can be commissioned in as little as a week.

CellCube History

1999 Research and development

2004 First field trials

2008 Market launch FB 10-100

2010 GILDEMEISTER investment

2011 Market launch FB 200-400

2012 Market launch modular systems in the MW-range

2014 Over 65 CellCubes commercially installed since launch



CellCube. Modular and flexible for any situation

The CellCube energy storage offers the operational flexibility to satisfy a wide range of applications from a single home up to utility scale.

The modular and flexible structure of the system allows for the independent scaling of power (10kW-10MW) and duration (1-13 hours).

CellCube Highlights:

- Turn-key energy storage self-contained in weather-proof and securely protected housing
- Practically unlimited cycling (No degradation over time)
- 100% Depth of Discharge capable
- Scalable to the MW-range through simple parallel connection of multiple CellCubes
- Non-flammable, Non-explosive
- Holistic system solution, including specially coordinated inverters, allowing connection to different energy sources
- Remote or online maintenance
- Climate controlled
- Optimal operational characteristics through intelligent battery management
- Standard freight containers allow simple and cost effective transport



Grid Connected Solutions



Renewable Energy Integration



Commercial & Industrial Solutions



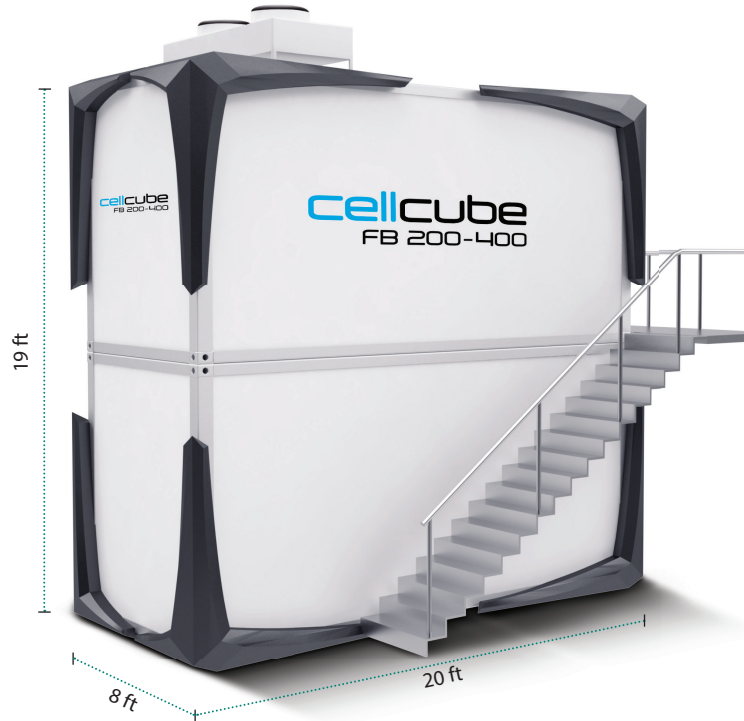
Microgrid Solutions

CellCube. The modular and scalable solution

The CellCube 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.

- Power element:
Stacks, flow battery controller,
DC/DC converter, inverter
- Energy element:
Negative and positive
electrolyte tanks, pump systems

100%
DEPTH OF DISCHARGE
UNLIMITED CYCLING



Available power and storage capacity

	Power output (kW)	Storage capacity (kWh)		
		400	800	1600
CellCube FB 200	200	400	800	1600



CellCube combination



FB 200 - 400
200 kW, 400 kWh



FB 400 - 1600
400 kW, 1600 kWh



FB 200 - 800
200 kW, 800 kWh



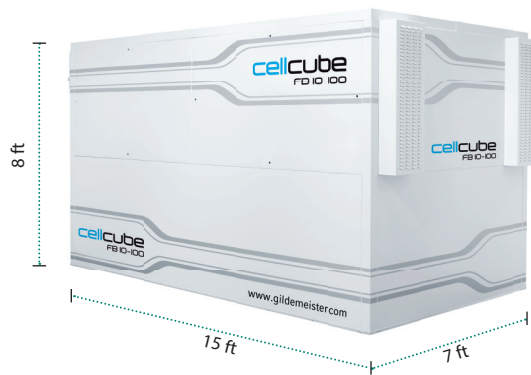
FB 400 - 800
400 kW, 800 kWh

CellCube. For residential and telecommunication applications

Flexible, modular and individually applicable - that is the 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 flexible, tailor-made implementation and a wide range of power and duration combinations.



- Power element flow battery: Controller, stacks, fluid lines
- Energy element: Negative and positive electrolyte tanks, pump systems







Available power and storage capacity

	Power output (kW)	Storage capacity (kWh)		
		40	70	130
CellCube FB 10	10	40	70	130
CellCube FB 20	20	40	70	130
CellCube FB 30	30	40	70	130



CellCube combination

	FB 10 - 100 10 kW, 100 kWh		2x FB 10 - 100 20 kW, 200 kWh
	1x FB 10 - 40 1x FB 20 - 70 1x FB 30 - 130 60kW, 240 kWh		2x FB 10 - 40 2x FB 30 - 130 80 kW, 340 kWh

Efficient power solutions

Stacks and electrolyte tanks: A stack is a number of serially connected cells, with electrolyte 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. The larger the electrolyte tanks - the greater the energy storage capacity.



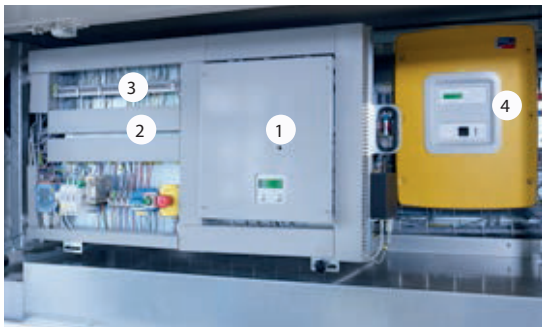
The electro-chemical process, which charges or discharges the battery, takes place in the cell stacks.

The electrolyte is pumped from the electrolyte tanks to the stacks and then flows back to the same tank via return lines.

Stacks

Modular flexibility / more stacks = higher output
Simple maintenance

Tested for 100% leakproof performance
Exchangeable membranes



- 1 Flow-Battery Controller (FBC)
- 2 DC bus bar
- 3 Transition converter (stacks) to DC bus bar
- 4 Inverter with AC connection



Service function monitoring:
All operational parameters can be monitored online, including: state of charge (SOC), electrolyte temperature or charging power. Additionally an optional monitoring touch display can be attached to the battery for local monitoring.

Integrated energy management system

Absolute safety and reliability is provided by sophisticated design and engineering: double-walled 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, American Vanadium offers tailor-made services and maintenance contracts for reliable supply of power for the system life.

Advanced vanadium technology combined with the highest German engineering standards with American Vanadium

Whether in combination with photovoltaic, wind power, diesel, gas and biogas generators or in parallel with the grid, the CellCube guarantees uninterrupted power supply.

American Vanadium Corp. is an integrated energy storage company that markets and sells GILDEMEISTER's CellCube vanadium redox flow batteries in North America. The CellCube energy storage system is regarded as a milestone in the history of regenerative energy management having been proven in the field over the last five years.

American Vanadium is also developing the only vanadium mine in the United States, providing a critical source of vanadium electrolyte for CellCube energy storage systems. The company's Gibellini Vanadium

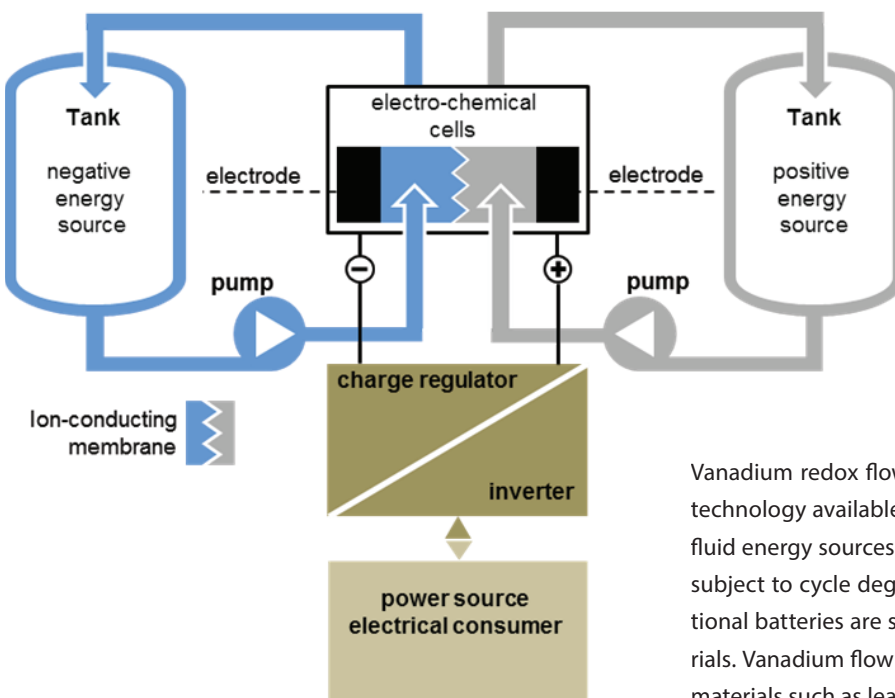
Project, located in Nevada, is being designed to produce high quality, competitively priced vanadium electrolyte for the energy storage industry.

The partnership of GILDEMEISTER and American Vanadium presents a unique opportunity to meet America's growing energy storage needs by combining the world's most advanced vanadium flow technology and America's only strategic supply of high purity vanadium electrolyte.

Standards and Certifications

- Building and Construction Standards: VDE/DIN/EN/ISO
- TUV
- CE
- Compatible with local grid codes

Vanadium redox flow technology



The vanadium electrolytes, or liquid energy sources, are stored in two tanks and pumped through the electro-chemical cells (stacks). Depending on the applied voltage, the energy sources are charged or discharged electro-chemically. The charge controller and inverter represent the interface to the electrical energy source and the user respectively.

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. Therefore, 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.

Technical Data

Performance and energy	CellCube FB 10/20/30 kW	CellCube FB 200 kW	
Nominal charge output	10/20/30 kW	200 kW	
Nominal discharge output	10/20/30 kW	200 kW	
Capacity of the energy storage system	40/70/100/130 kWh	400/800/1600 kWh	
Battery and system voltage			
Output voltage system	- 48 VDC; 120 VAC; 208 VAC (1-phase); 208 VAC (3-phase) WYE; 240 VAC (split-phase)	480 VAC	
Duration of connection / Reaction time	grid independent: < 20 ms remote converter: < 8 ms		
Control system			
Control via external interfaces	serial, TCP / I P, bus systems		
Monitoring			
Condition detection via remote monitoring by email	State of charge (SOC), available energy, charge / discharge power output, and more		
Efficiency			
Charge / discharge cycle DC	up to 80%	up to 70%	
Multi-stage management reduces power losses	3 independent, switchable circuits with energy efficient pump control system	4 independent, switchable circuits with energy efficient pump control system	
Discharge time at nominal power output		DC battery power	AC inverter power
Discharge time (autonomy)	Depends on power output and capacity		
1 hour **		220 kW	200 kVa
2 hours **		140 kW	130 kVa
3.5 hours **		110 kW	100 kVa
5 hours **		80 kW	70 kVa
Self-discharge			
Self-discharge in standby **	< 150 W	< 200 W	
Self-discharge in tank	negligible (<1 % per year)	negligible (<1 % per year)	
Size and weight			
Dimensions L x W x H	15 ft x 7ft x 8 ft	20 ft x 8 ft x 19 ft	
Weight (empty condition)	3,600 kg - 4,500 kg	18,000 kg - 38,000 kg	
Gross weight (filled condition)	7,000 kg - 14,000 kg	57,000 kg - 191,000 kg	
Climate operating conditions			
Climate control	-40°C to + 50 °C (monthly average temperature)		
	The inside temperature is climate controlled between 20°C and 30°C by an intelligent temperature management system. Environmentally controlled CellCube modules allow for deployment in any climate.		
* Base unit. ** Subject to change.			

Contact us!

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