

The logo for Redox, featuring the word "REDOX" in a sans-serif font. The letter "O" is stylized with a vertical line through its center, resembling a battery cell or a chemical symbol. The logo is positioned in the top left corner of the slide, within a white rounded rectangular shape.

REDOX

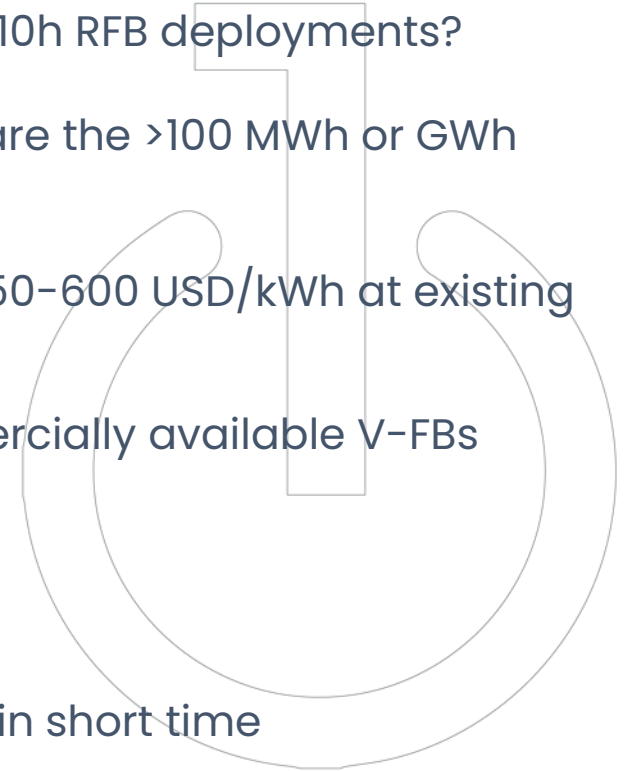
Advances in Low-Cost Manufacturing of Flow Batteries

Tom Gebauer, CEO

Swiss Battery Days, August 2024

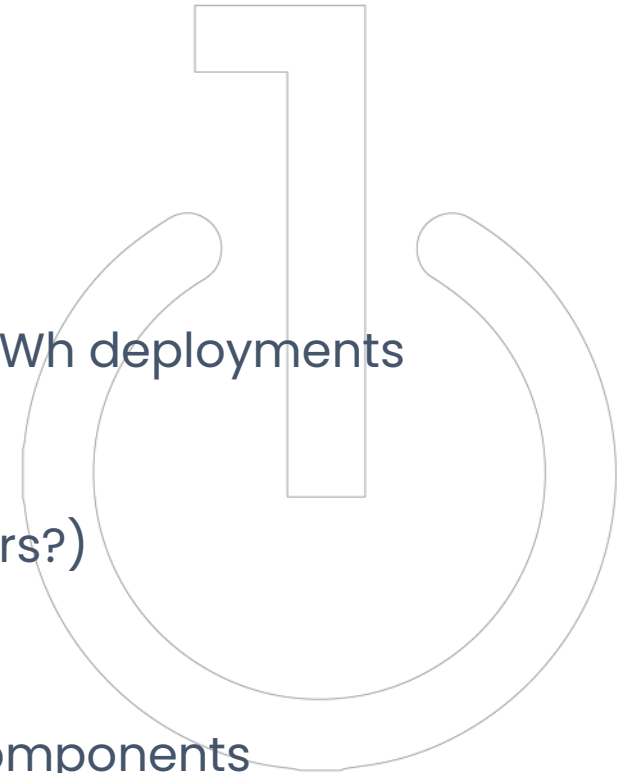
SOME HARD FACTS ABOUT FLOW BATTERIES

- FBs are best suited for **longer-duration energy storage** – but where are all the 8-10h RFB deployments?
- FBs are best suited for applications where **large capacity** is needed – but where are the >100 MWh or GWh deployments (outside of PRC)
- FB manufacturing cost need to be around **<200 USD/kWh** – but are at between 450-600 USD/kWh at existing (non-subsidized) V-FB deployments?
 - Electrolyte cost on 5 year-average are between 180-200 USD/kWh for commercially available V-FBs
- Is the **(local) FB supply chain** well developed?
 - Where can you get >100 MWh equivalent of electrolyte in short time
 - Where can you get >100 MW equivalent of RFB stacks and stack components in short time
- Can you build a **sustainable billion-dollar business** by manufacturing and selling batteries at low margins? Who makes the most money in the energy storage business? – It's the owners and operators of storage solutions



LESSONS LEARNED FROM FB COMMERCIALIZATION

- Focus on **8-10h (or longer)** durations
- Focus on **>100 MWh or GWh** deployments
- Drive **down manufacturing cost**, namely
 - **Electrolyte** cost – dominating cost factor for long duration MWh or GWh deployments
 - **BOP** (cost-efficient system design)
 - Active **stack components** – namely felts and membranes (separators?)
 - Power **electronics**
- Built your (**local**) supply chain for commodity (and costly-to ship) RFB components
- **Own and operate** your battery solutions and built a sustainable billion-dollar company
- Become a focused and **well-established RFB supplier** in case you don't build complete systems



From Ground to Gigawatt-hour

WHO IS REDOX ONE



Developer and Manufacturer of Iron-Chromium flow batteries for industrial energy storage solutions
Manufacturer of Iron-Chromium electrolyte
Operator of BESS



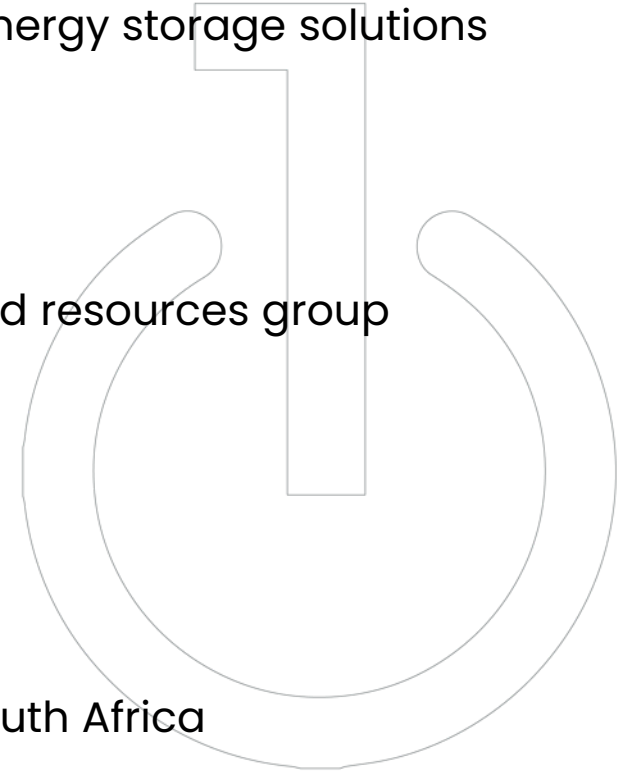
Founded in Dec 2022 as spin off from Tharisa plc a European based integrated resources group listed in London and Johannesburg
Bought IP from Enervault and Deeja/Imergy



HQ in Cyprus
European technology centre in Dortmund, Germany
Testing centre and Fe-Cr electrolyte manufacturing facility in Buffelspoort, South Africa



Team of 42 energy storage experts with background in batteries, metallurgy and chemical processing, growing fast



REDOX ONE ADVANTAGE

Secured multi-generational Fe & Cr supply for electrolyte manufacturing (equivalent to 75 GWh capacity)

Manufacturing our own electrolyte (GWh equivalent) in a continuous process straight from the ore at a fraction of the V-electrolyte cost (>80% cost savings per kWh)

We design RFBs for long duration, large capacity applications only in a modular approach

- 10 MWh submodule consisting of a
- Power block (stacks etc.)
- Capacity block (electrolyte tanks)
- Rebalancing block


We use microporous separators instead of membranes (much cheaper than conventional V-FB membranes, available in large quantities, functioning supply chain)


We are building **LOCAL** supply chains for commodity (and costly-to-ship) RFB components in 3 key geographic markets

We own and operate our battery solutions




FROM GROUND TO GWH

 Fe-Cr electrolyte cost a fraction of vanadium flow battery electrolyte cost

 Low-cost stack components and simplified system components

 Covering the whole manufacturing process from raw material mining to MW storage solutions

 competitive storage solution system cost **at <u>200 USD/kWh</u>**



Mining



Crushing & Separation



Concentrate



Smelting



Purification



Electrolytes used in batteries

REDOX ONE ROADMAP

TRIAL PHASE
2023



20 kWh to 200 kWh

DEMONSTRATION PHASE
2024 - 2025



200 kWh to 20 MWh

DEPLOYMENT PHASE
2026+



50 to 100 MWh & beyond

STRONG PARTNERSHIPS



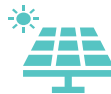
USD40 million in funding secured



Multi-generational Fe & Cr supply for electrolyte manufacturing (GWh)



System integration partners for MWh storage projects



Demo customers signed up for 5 MWh installations



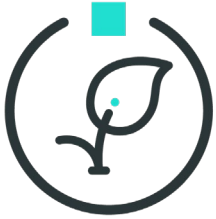
Well-connected in the MENA with Demo installations planned



tharisa



Iron-Chromium Redox Flow Batteries



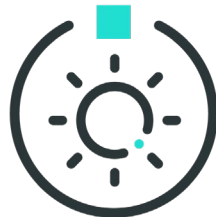
Secure Supply

Access To multi-generational Chromium supply



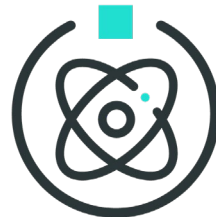
Safe

Non-flammable, no leakage, non-explosive



High-Temperature Stable

60°C operating temperature



Fully recyclable

Electrolyte is fully reusable, made from earth-abundant Fe & Cr



Switched On. Always.

Power and Capacity fully decoupled to meet any application



Competitive Cost

Grid-Scale Cost at <200 USD/kWh and easily scalable

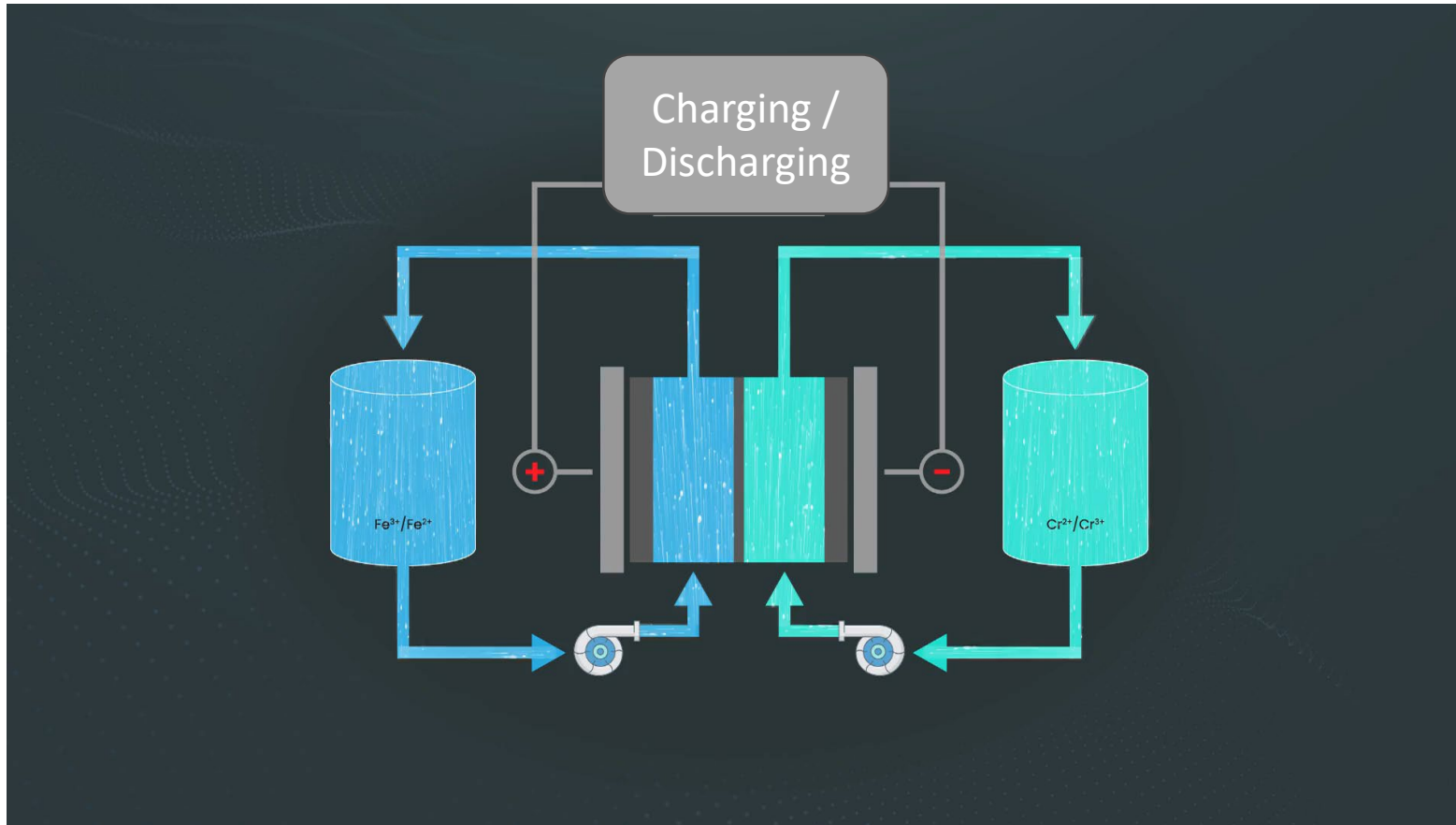


Reliable

20+ year operational life, no limit to calendar or cycle life of electrolyte

REDOX

How our Iron-Chromium Flow Battery Works



Both electrolyte tanks contain equal concentrations of Iron (Fe) & Chromium (Cr)

Charging:

- Fe^{+2} oxidized to Fe^{+3}
 - Cr^{+3} reduced to Cr^{+2}
- (Accepts electron & gains electric potential energy)

Discharging:

- Fe^{+3} reduced to Fe^{+2}
 - Cr^{+2} oxidized to Cr^{+3}
- (Gives electron & releases electric potential energy)

SIMPLE - like pumping water through a filter, direct access to electrolyte ensures accurate State of Health and State of Charge

RESPONSIVE - can track load, increase or decrease output, go from charging to discharging in milliseconds

RELIABLE – Other flow batteries use highly sensitive ionic membranes, instead Redox One uses a micro porous separator at about 0.5% of the cost and significantly more reliable

SELLING ENERGY STORAGE SOLUTIONS AND ULTIMATELY POWER

Applications

- Energy Shifting
- Capacity provisioning
- T&D optimization
- Supporting Micro grids
- Stability services
- Firming for renewable energy PPAs



Customers

- Industries with remote or unreliable grids (mining, manufacturing, etc.)
- Island/Micro grids
- Utilities for grid-scale energy shifting

REDOX

Connect with us

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Redox One

Switched On. Always.