

redT
energy storage

Maximise Your Energy



2017 Brochure

redTenergy.com

Maximise Renewable Utilisation
Hedge Against Energy Prices
Save On Grid Purchases

100% Depth Of Discharge
No Heavy Metals
No Thermal Runaway

The redT energy storage machine

After 15 years of research and development, redT has developed a new and proprietary energy storage machine which enables the efficient and sustainable storage of electrical energy in liquid form

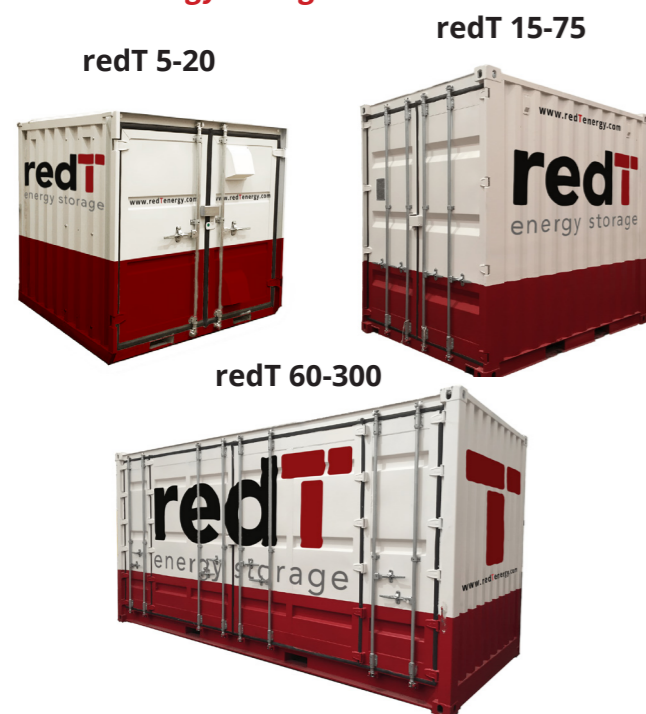
Who is redT?

We develop and supply durable and robust energy storage machines for use in a wide range of on and off-grid industrial, commercial and grid-scale applications.

Unlike conventional batteries, where energy is stored in a cell, our patented energy storage modules store energy in a liquid. This technology does not degrade like conventional batteries and affords exceptionally long life with (100%) discharge functionality, making the system perfectly suited to integration alongside renewables such as wind and solar.

The system is equally well suited to working alongside diesel generators in off-grid applications, improving efficiency and reducing expenditure on fuel and other associated costs.

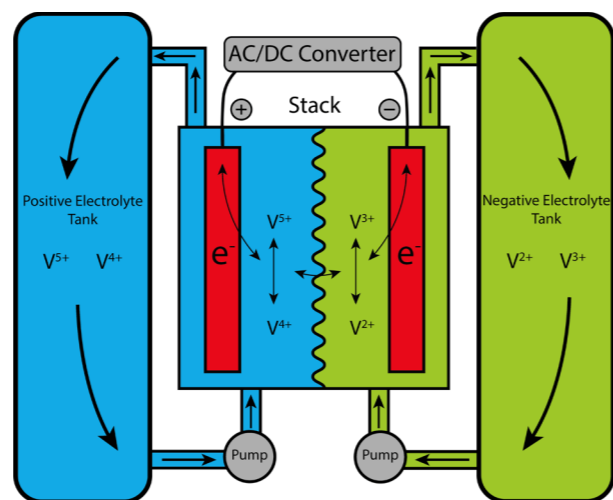
The redT energy storage machines



How does it work?

Vanadium Redox Flow Machine (VRFM) technology utilises the flow of vanadium electrolyte across an ion exchange membrane. When this occurs, a reversible electrochemical reaction takes place, allowing electrical energy to be stored and subsequently returned.

The technology relies on the ability of Vanadium to exist in four different oxidation states (V^{2+} , V^{3+} , V^{4+} , and V^{5+}), each of which holds a different electrical charge.



Demonstrated by the diagram above, the electrolyte in the negative half-cell contains V^{3+} and V^{2+} ions, whilst the electrolyte in the positive half-cell contains V^{4+} and V^{5+} ions. This represents the machine in its charged state. On discharge, a redox reaction occurs in the central stack, creating a surplus of electrons at the negative terminal, generating an electrical current.

The setup of the electrolyte and the membrane stack can be compared to that of an engine and fuel tanks. The membrane stack ('engine') delivers power rated in kilowatts (kW), whilst the fuel (the vanadium electrolyte) delivers energy rated in kilowatt hours (kWh).

Applications

The modular, versatile nature of redT energy storage machines make them suitable for a wide range of applications, from small off-grid sites to large-scale, grid-connected, solar and wind installations



Renewables

A key issue in supplying renewable energy to the grid is the mismatch between availability and demand. redT energy storage is ideal for coupling to renewables, such as PV and wind. Unlike most energy storage systems, it does not degrade, even when performing 100% charge/discharge cycles, and is suited to long duration storage, meaning it can handle the high volatility inherent in renewable generation. The machine's life also matches that of renewable assets (25 years), further minimising costs.

Use redT energy storage with renewables to maximise your utilisation through time-shifting and peak shaving, remove constraints on existing renewable generation or gain full autonomy from the grid.



Grid Services

Conventional power plants have traditionally provided both energy and grid balancing services. However, with the increasing proliferation of renewable energy, the grid must now adapt to the larger share of mid-to-low power generation, leaving utilities with the issue of how to perform grid services.

redT energy storage is capable of performing grid services at both transmission and distribution levels, requiring discharge durations ranging from seconds to days and power ratings from 100kW - 10MW. Use the machine to provide capacity to the grid for balancing, deferral, congestion relief and other services - opening up new revenue streams and maximising your return on investment.



Off-Grid

Energy storage provides a solution for locations with a weak or non-existent grid connection. redT machines are equally well-suited to coupling with renewables, diesel generators or a combination of the two.

For renewables, the energy storage machine can absorb intermittent and volatile generation and time-shift it for when there is demand. redT systems can also stabilise the addition of renewables to a micro-grid, enabling maximum flexibility of operation.

For non-renewables, a diesel genset can run 3x more efficiently at full loads than low loads. By coupling diesel assets with redT energy storage, the genset can run at a higher loading to charge the machine whilst still supplying demand. This not only reduces fuel consumption (as the genset is only run at optimised efficiencies) but also prolongs the life of the generator, reducing replacement and maintenance requirements, leading to significantly lower total operating costs.



Telco

In order to provide extensive coverage, telecommunications stations often need to be installed in remote locations where diesel generators must be used due to weak or non-existent grid connections.

redT energy storage machines reduce site operating costs by increasing generator efficiency, and have the potential to eliminate the need for fuel when used alongside sufficient solar PV assets.

The low maintenance requirements and remote monitoring capability of the redT system minimises the need for site attendance and, unlike lead-acid batteries, the system is not a target for theft as there is no easily accessible secondary market for vanadium.

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Avoid Curtailment
 Maximise Self-Consumption
 Low Maintenance Requirements

Long Service Life - 20+ Years
 High Efficiency
 Low Levelised Cost of Storage

The redT advantage

The redT energy storage machine offers numerous advantages when compared to other technologies available on the market today

- 100% Depth of Discharge**
 Charge and discharge the system fully from 0-100% without significant degradation, unlike conventional batteries which suffer drastic capacity loss if discharged below 50%
- Low Levelised Cost of Storage (LCOS)**
 LCOS calculates the cost of storage over a system's life and accounts for all operating and maintenance costs, together with efficiency
- Long Lasting**
 The machine can last for 25 years with no significant degradation, matching the life of solar and wind assets
- Low Maintenance**
 The system can be monitored remotely and requires minimal maintenance, reducing the need for frequent site visits
- Safe**
 Unlike lead acid and lithium batteries, the redT energy storage machine is at no risk of thermal runaway and is non-explosive and non-flammable
- Environmentally Friendly**
 redT energy storage machines contain no heavy metals and are emission free. The electrolyte is fully reusable and recyclable, alongside the majority of components used in the system

The redT advantage

What can energy storage do for your business?

Save on grid purchases

redT energy storage machines enable you to store energy from a renewable source to offset power purchases from the grid. Using an energy storage machine will also allow you to take part in arbitrage activities (peak/off-peak prices) and avoid time of use or Triad charges.

Maximise utilisation of renewables

Increase the amount of renewable energy you use by storing excess generation - right up to 100% renewable and full grid independence.

redT energy storage systems are ideal for coupling to renewables, such as PV and wind. Unlike most energy storage systems, it does not degrade when fully discharged and is suited to long duration storage. This means it can handle the high volatility and diurnal cycle characteristics of these sources.

Make the most of constrained grid connections

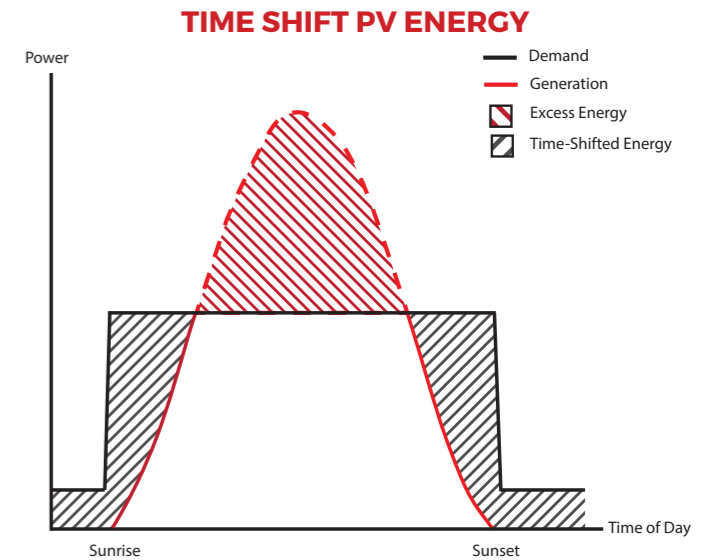
Connection upgrades can cost several hundred thousand Euros, depending on the location, size and type. Installing a redT energy storage machine can avoid this, allowing you to increase self-consumption, and import and export power when there is spare capacity.

Lengthy upgrade permitting times can also delay developments, losing income from failure to lock in FIT or other generation payments. A redT system can enable projects to go ahead today and for full generation payments to be secured even where line capacity is below generating potential.

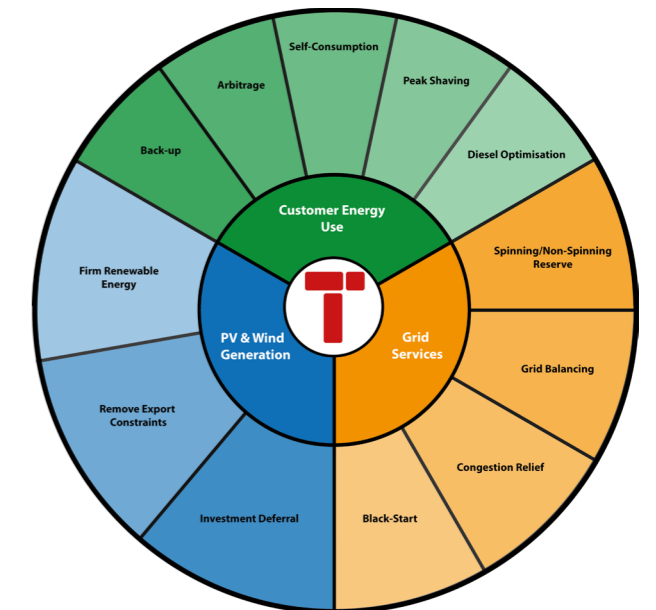
Your own utility asset - hedge energy prices

Invest in your own utility infrastructure. Whilst lead acid and lithium batteries may require frequent replacement, a redT energy storage machine can last 25 years in typical use, matching the life of solar and wind installations.

Use storage with renewables to reduce exposure to energy prices, which have increased by an average of 10% per year over the past 5 years. In addition to this, the system may earn additional income providing support services to the grid, a market which is expected to grow rapidly as existing infrastructure comes under increased strain.



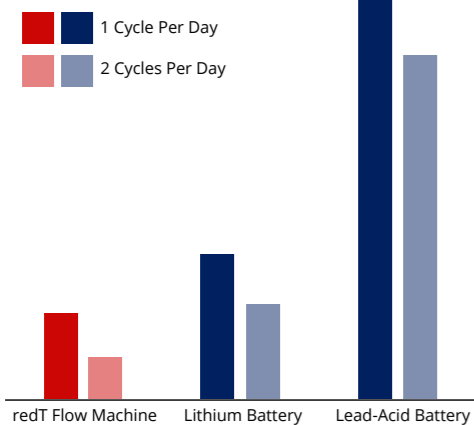
STACK MULTIPLE SERVICES



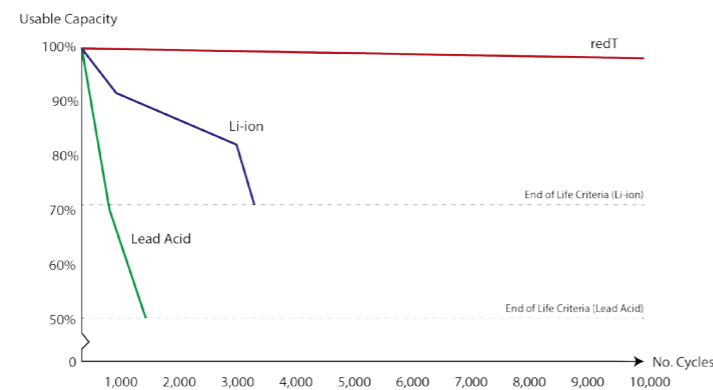
Utilise a redT energy storage machine as a long term, revenue producing asset. Because redT energy storage machines do not degrade like conventional batteries, there is no additional cost of extra services.

As demonstrated by the diagram above, utilise storage for multiple revenue streams, either behind the meter in C & I applications or in-front of the meter at generation & distribution level.

LEVELISED COST OF STORAGE (LCOS)



USABLE CAPACITY VS CYCLE LIFE



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Modular Energy Storage

Combine multiple redT energy storage machines for kW to MW scale storage

One of the key features of the redT energy storage machine is its ability to separate power (kW) from energy (kWh), making the system easily scalable. The stack size determines the power, whilst the electrolyte volume determines the energy.

Our energy storage range is based on the redT 5kW stack module and by using this 5kW stack as a 'building block', it is possible to build bespoke systems up to MW scale.

Further details of our systems can be seen below:

Unit Name	Power (kW)	Capacity (kWh)	Continuous discharge at rated power †	Dimensions
redT 5-20	5	20	4 hours	6ft ISO
redT 5-40	5	40	8 hours	9ft ISO
redT 5-75	5	75	15 hours	10ft HC
redT 10-75	10	75	7.5 hours	
redT 15-75	15	75	5 hours	
redT 10-150	10	150	15 hours	20ft HC
redT 20-150	20	150	7.5 hours	
redT 30-150	30	150	5 hours	
redT 15-225	15	225	15 hours	
redT 30-225	30	225	7.5 hours	
redT 45-225	45	225	5 hours	
redT 20-300	20	300	15 hours	
redT 40-300	40	300	7.5 hours	
redT 60-300	60	300	5 hours	
redT 500-2500	500	2500	5 hours	
redT 1MW-5MWh	1000	5000	5 hours	
redT 5MW-25MWh	5000	25000	5 hours	
redT 10MW-50MWh	10000	50000	5 hours	

† Discharge duration is proportional to power requirements i.e. if discharging at 50% rated power, duration is doubled.

Note: redT energy withhold the right to change product specification without prior notice. Please consult redTenergy.com for latest specifications



redT 5-20



redT 60-300

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