Lithium-ion battery life

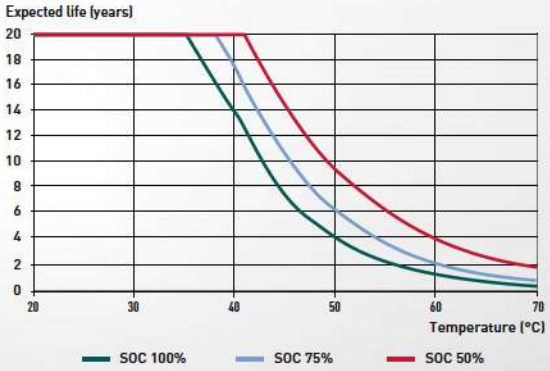
Solar photovoltaic (PV) — Energy Storage Systems (ESS)

What does battery life really mean?

There are two distinct, but inter-related ways that are used to measure the life of lithium-ion (Li-ion) batteries deployed in ESS applications for solar photovoltaic (PV) installations – calendar life and cycle life. Both are important.

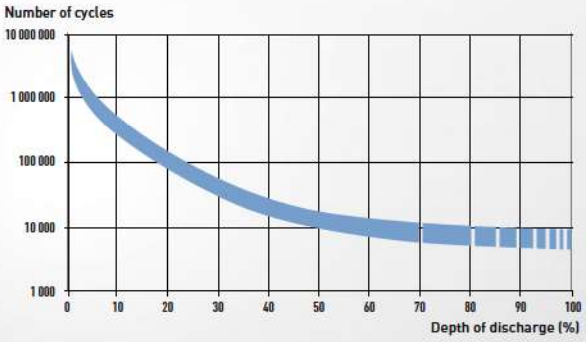
Calendar life is simply how long the battery might be expected to last in terms of calendar years. It is independent of how much the battery is charged and discharged. But it is influenced by the state of charge (SOC), which reflects how much charge is kept in the battery, and its operating temperature.

Expected life for VL Li-ion cells according to temperature (EOL for capacity loss of 20%)



Cycle life is expressed in terms of the number of charge and discharge cycles that can be achieved depending to what level the battery is discharged – its 'depth of discharge' or DOD. It is influenced by both the DOD and the charging rate.

Cycle life at + 25°C/+ 77°F



Energy applications 70% capacity at EOL

When does a Li-ion battery reach its end of life (EOL)?

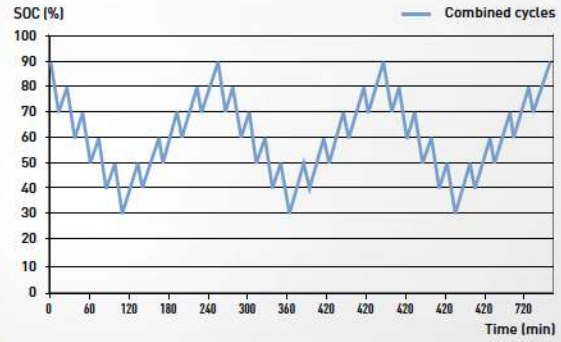
In contrast to other battery technologies, such as lead-acid batteries, Li-ion batteries do not suffer from 'sudden-death' failure. Instead they exhibit a gradual decrease in performance over their service life. So their end of life (EOL) is defined either by a reduction in initial capacity (typically 20 to 30%) or increase in impedance – which is important for power applications. It is important to remember that a Li-ion battery is not 'dead' at its EOL, it has simply reached a pre-defined measure of ageing.

saft

Saft Li-ion batteries – lifetime tests in real-world PV applications

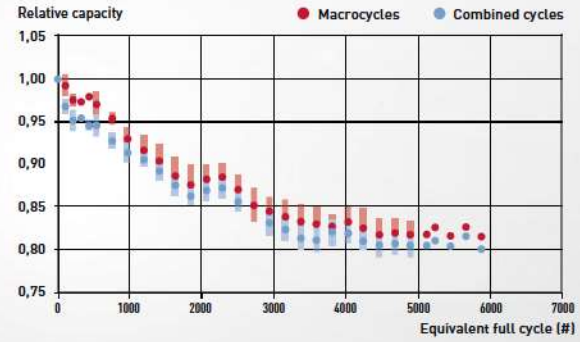
The Sol-ion project saw Li-ion batteries deployed for energy storage in PV systems on the largest scale in Europe to date. This provided the opportunity for Saft's Li-ion battery to be tested by independent research institutes[1] in different charge and discharge cycle profiles.
A key test focused on the realistic representation of the very complex and random cycling experienced in a PV application, with micro-cycles due to PV intermittency superimposed on macro-cycles due to energy demand shifting between day and evening.

Cycle profile defined for testing



Test Conditions:
Temperature = 40 °C
Charging current: 0.5 C (20.5 A)
Discharge current: 1 C (41 A)

Influence of the cycle depth on Saft's battery system

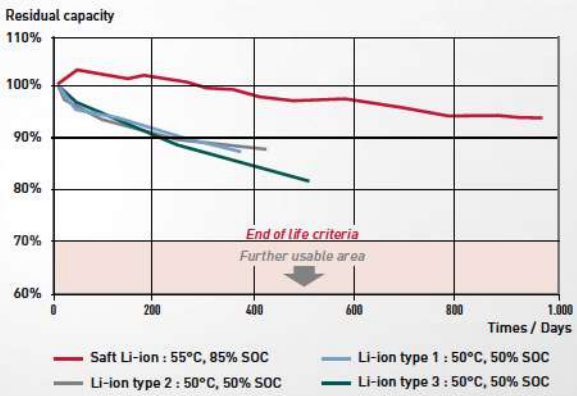


The tests showed that Saft's battery had a capacity loss of only 20% after the equivalent of 6000 full cycles (1 full cycle = 100% of battery energy charged and discharged)

Saft VL Li-ion batteries outperform the competition

Tests carried out against other types of Li-ion battery show that Saft's VL Li-ion battery technology is superior in both calendar life and cycle life.

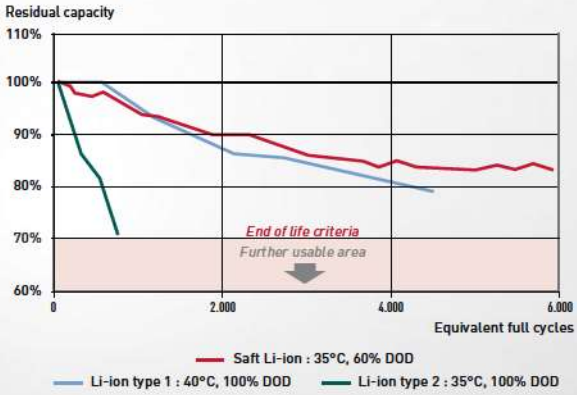
Calendar life time



Source: ISEA/RWTH/Bosch

Calendar life testing is usually carried out at higher temperatures in order to achieve meaningful results in a shorter time frame. In this case, one year calendar life time at 50°C corresponds to approximately 5.6 years at 25°C.

Cycling life time



Source: ISEA/RWTH/Bosch

There are considerable differences in the cycle life offered by the various types of Li-ion cell commercially available for PV applications. The Saft battery maintains its high capacity, even after more than 6,000 charge/discharge cycles.

Battery life time predictions – based on 20 years of practical and experimental evidence

The battery life time information presented here draws on Saft's 20 years broad experience in R&D, technology development and industrialization of Li-ion chemistry. Combined with Saft's capabilities in long term lab-testing, characterization and modeling, this ensures the complete accuracy and reliability of the system life time and performance projections.