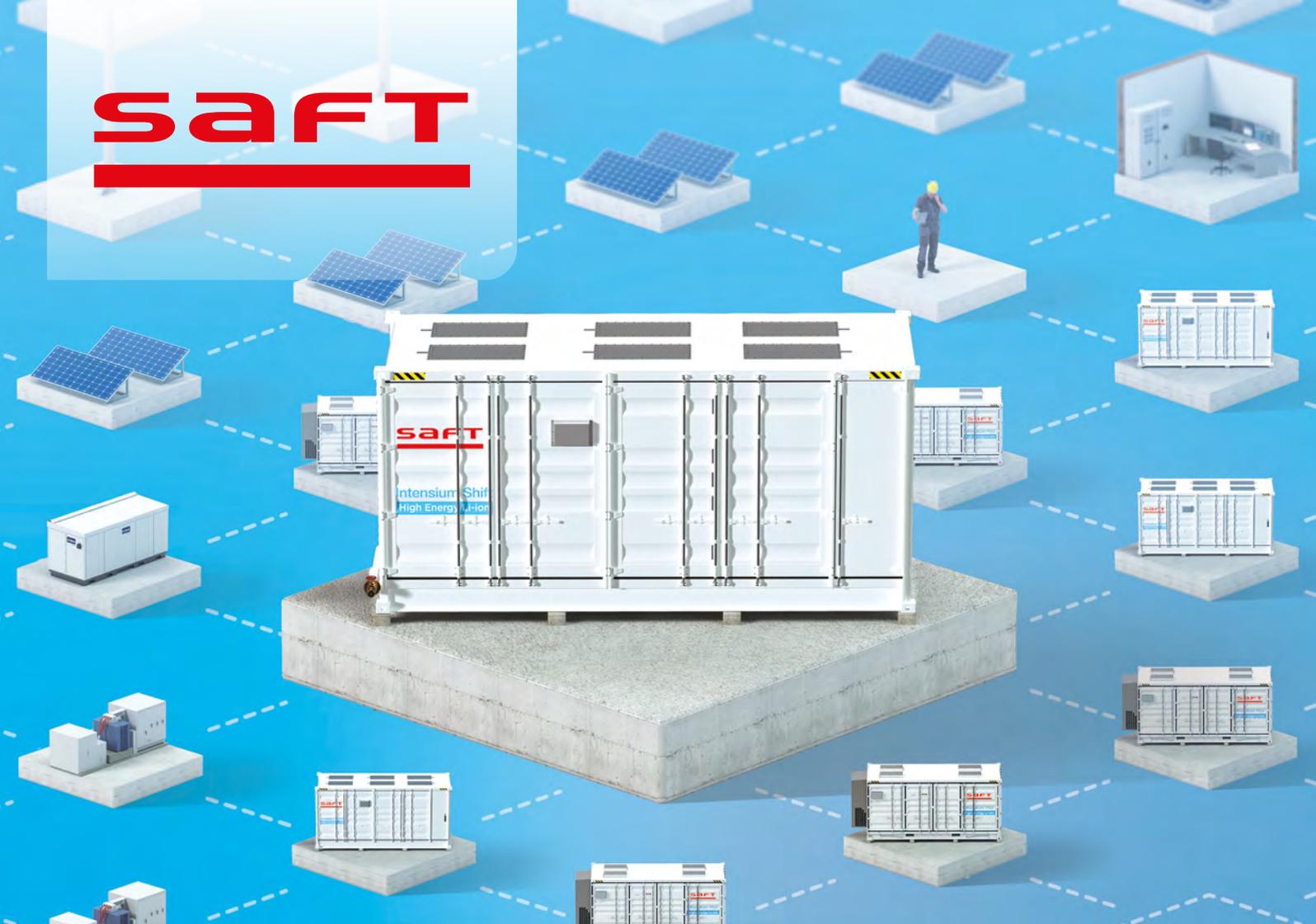


**saft**



# Energy Storage Systems

Turnkey solutions from the battery experts.



**TotalEnergies**



# Driving for net zero by 2050

In 2020 the United Nations set a target for the world's governments to achieve net zero carbon dioxide emissions by 2050. To achieve this, energy networks must transition to green and clean renewable energy sources - that means tackling the triple D challenge.



## Decentralization

Small plants distributed across the grid will generate electricity.



## Decarbonization

The world is embracing wind, solar and hydro power.



## Digitalization

To provide control and stability for multiple asset.



# Why is energy storage crucial?

Energy storage delivers the resilience and flexibility to address the triple D challenge. It helps to balance demand and supply, supports grid stability, eliminates curtailment of renewables and facilitates new revenue streams and innovative business models.

## Advantages of Li-ion Energy Storage Systems

### CLEAN ENERGY

- Support integration and higher penetration of renewable energy
- Cut emissions by taking the load off fossil fuel generation for peaking and ancillary services

### ENERGY EFFICIENCY

- Outperforms other technologies with faster ramp rate, response time and precise control
- Allows other grid resources to operate at their optimum efficiency point

### DECENTRALIZED & CUSTOMIZED

- Scalable and flexible at any level of the grid from a few kW to hundreds of MW
- Suitable for fast-track deployment

### SYSTEM STABILITY & INTEGRATION

- Digital control of multiple distributed assets provides flexibility and resilience
- Enables real-time aggregation and demand response management



# One-stop shop for energy storage

# Adding value as a 360° partner

Saft's complete energy storage solutions are tailored to your specific needs and are based on our extensive battery expertise. We work in partnership with our customers from inception to end-of-life. This includes:

Our solutions support renewable energy generation, transmission and distribution grid operations, microgrids and behind-the-meter applications in industrial and commercial sites. Saft is not just a technology supplier. Our extensive experience enables us to be a one-stop shop for energy storage.

This ensures:

- ✔ **Secure operation**  
Even in the harshest conditions
- ✔ **Secure revenue**  
Through the highest possible availability
- ✔ **Secure customer service**  
Meeting stringent safety and reliability standards

Our aim is always to **deliver the lowest levelized cost of storage (LCOS) and the lowest possible carbon footprint** while matching long lifetime's compatible with other power infrastructure assets.



- 1 Engineering**
  - Sizing and modelling
  - System architecture
  - Qualification
- 2 Turnkey solution**
  - Li-ion battery
  - Power conversion
  - Power management
- 3 Project execution**
  - Manufacturing
  - Installation and commissioning
  - Grid connection
- 4 Operation support**
  - Spare parts
  - Maintenance
  - Remote condition monitoring
- 5 End of life**
  - Dismantling
  - Transportation
  - Recycling

# Flexible solutions for multiple roles

The global energy transition is driving the evolution of new energy storage applications along the electricity value chain. Saft's Intensium® range provides the DC battery building blocks to match our customers' needs in terms of system size and operational profile. Our Intensium® Max and Intensium® Shift solutions support the most demanding applications along the entire electricity value chain from generation to consumption, ranging from intensive, high-power cycling to long-term energy shifting. Whatever the required system size and the intended combination of battery functions, Saft provides the right battery with the optimum power, energy and cycling characteristics.



Intensium® Shift utility-scale ESS

## Renewables

**1 MW > 200 MW\***  
**1 MWh > 1 GWh\***

**Main functional purpose:**

- Integrate variable RES: mitigate variability and enable dispatchability.

- Dispatching / Shifting
- Shaping
- Curtailment avoidance
- Firming
- Smoothing
- Ramping



Intensium® Max utility-scale ESS

## Grid

**1 MW > 100 MW\***  
**1 MWh > 200 MWh\***

**Main functional purpose:**

- Ensure stability and capacity of the power system and grid.

- System Capacity
- T&D grid support
- Frequency regulation
- Voltage regulation
- Inertia



Intensium® Max microgrid

## Microgrid / C&I\*\*

**0.1 MW > 10 MW\***  
**0.2 MWh > 20 MWh\***

**Main functional purpose:**

- Maximise use of RES
- Ensure stability and resilience of microgrids
- Optimize energy usage

- PV/Wind harvesting and self-consumption
- Peak reduction
- Resiliency
- Spinning reserve
- Diesel optimization

### Balancing Energy and Power

Some ESS applications need high energy storage capacity to provide a steady flow of electricity over a duration of 2-4 hours. For example, time-shifting of photovoltaic energy for use in the evening or peak shaving. In contrast, high power is required over a short duration of minutes to deliver frequency response or spinning reserves. In practice, most ESS applications combine two or more of these services. Saft solutions enable to configure ESS with optimum energy (MWh) and power (MW) for each specific use case and for system sizes up to several hundreds of MWh / MW.

### Mixed operation profiles and application stacking

In demanding use cases where a single ESS needs to provide two or more services, the charge and discharge pattern can become highly dynamic and involve frequent power peaks. It can also require daily energy throughput exceeding 100 % of the battery's nominal capacity. Saft solutions adapt to evolving multi-application schemes and allow to stack multiple services, sustaining intensive power and energy throughput demands throughout their operational lifetime.

\*Typical size of storage system. \*\*Commercial & Industrial.

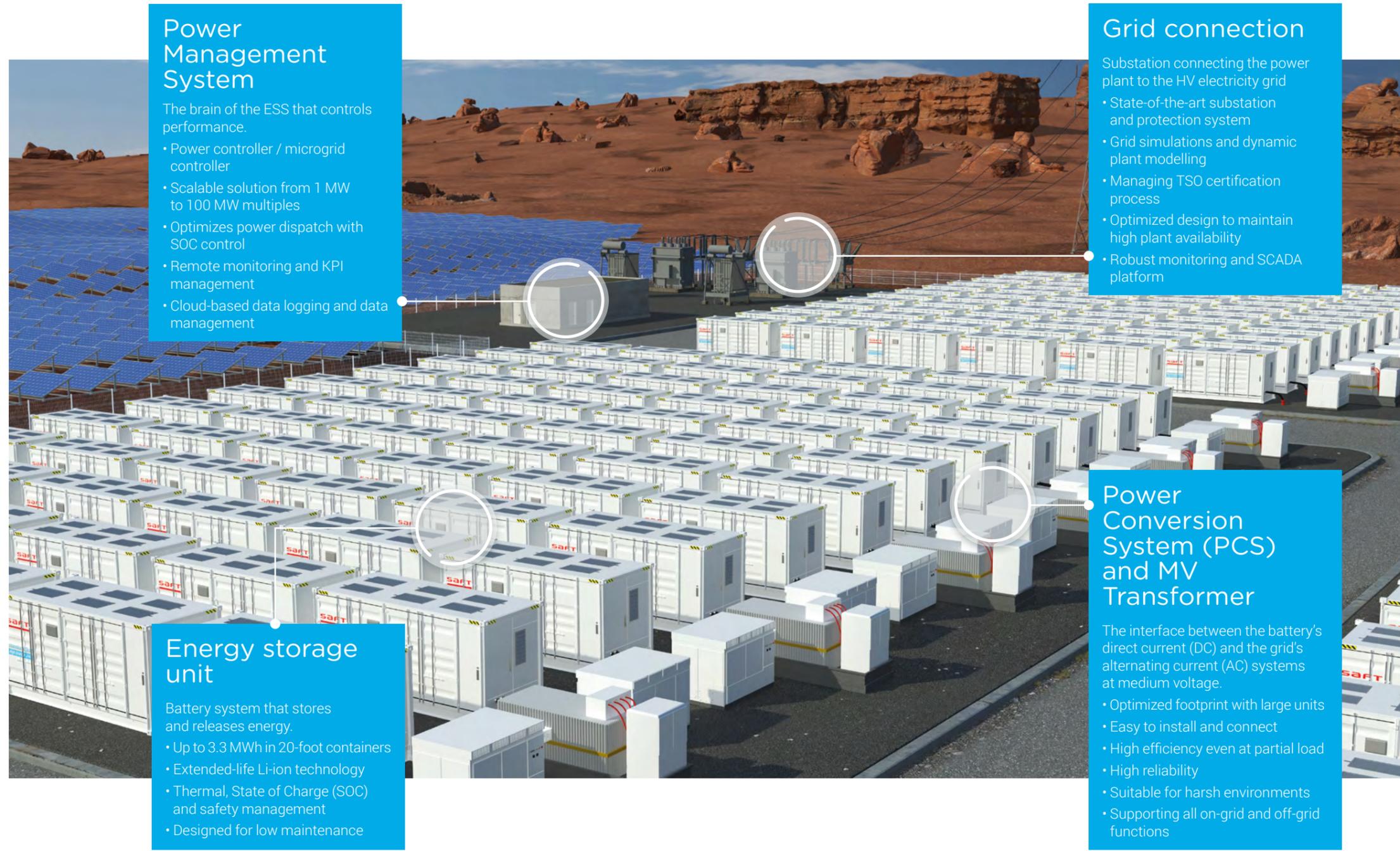
# Fully integrated solutions

## Saft's complete life cycle approach

Saft has extensive field experience in the design and engineering of large, complex energy storage systems. We provide a complete plug-and-play service from energy generation to grid connection. By taking responsibility for full system engineering, we guarantee system performance and meet your needs from inception to completion. The benefit is the simplicity of a single interface throughout the project life cycle.

## Saft's turnkey ESS service includes:

- Full-service approach based on field-proven technology
- Supervision from development and project management to operations
- Design, sizing and manufacture of the ESS
- Specification, qualification and supply of the PCS and transformer
- Network connection and integration
- Extended warranties and performance guarantees



**Power Management System**  
The brain of the ESS that controls performance.

- Power controller / microgrid controller
- Scalable solution from 1 MW to 100 MW multiples
- Optimizes power dispatch with SOC control
- Remote monitoring and KPI management
- Cloud-based data logging and data management

**Grid connection**

Substation connecting the power plant to the HV electricity grid

- State-of-the-art substation and protection system
- Grid simulations and dynamic plant modelling
- Managing TSO certification process
- Optimized design to maintain high plant availability
- Robust monitoring and SCADA platform

**Energy storage unit**

Battery system that stores and releases energy.

- Up to 3.3 MWh in 20-foot containers
- Extended-life Li-ion technology
- Thermal, State of Charge (SOC) and safety management
- Designed for low maintenance

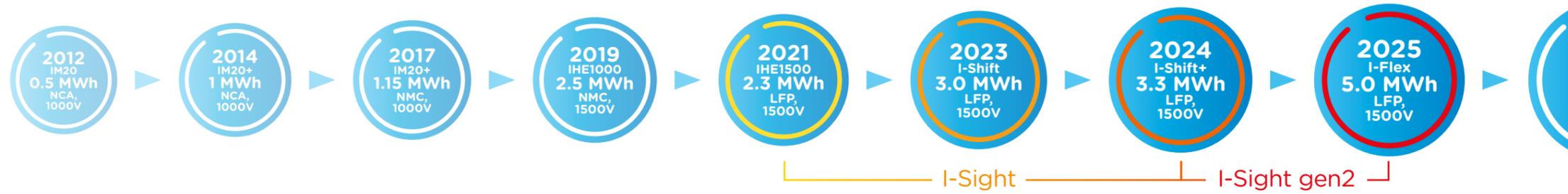
**Power Conversion System (PCS) and MV Transformer**

The interface between the battery's direct current (DC) and the grid's alternating current (AC) systems at medium voltage.

- Optimized footprint with large units
- Easy to install and connect
- High efficiency even at partial load
- High reliability
- Suitable for harsh environments
- Supporting all on-grid and off-grid functions

## Continuous innovation

New container generations integrate a decade of field experience and offer higher energy, better performance and enhanced maintainability.



Example of turnkey ESS system for 4 h energy shifting. Built with 8 MW twin-lineups of 12 i-Shift containers each.

# Why choose Saft battery technology?

Saft has been manufacturing batteries for more than a century and is a pioneer in Li-ion technology with over 10 years of field experience in grid-connected energy storage systems. Customers turn to us for advanced, high-end ESS solutions for demanding applications. Our focus on **safety, reliability, performance and long life** in even the harshest conditions enables customers to unlock their full business value.

**Saft's technology maximizes revenues through three key advantages:**

- Low TCO** **Highest energy efficiency** by holistic system design and granular component management. A Saft ESS delivers 85 to 90 % AC round trip efficiency, depending on usage.
- Long lifetime** of 15 to 20 years thanks to advanced cell technology, sophisticated battery control and SOC management. Our design ensures consistent aging across all cells by optimizing temperature conditions.
- High availability** design for maintainability and repairability keeps downtime to a minimum. Predictability is provided through advanced control, remote supervision, diagnostics and comprehensive after-sales service.

## Reduced on-site logistics

Our certified plug-and-play battery building blocks **minimize cost, time, risk and manpower.**



## Battery building blocks

Intensium® Max and Intensium® Shift containers are modular direct current (DC) building blocks that enable straightforward deployment and flexibility for future upgrades.

Intensium® Max is designed for dynamic cycling in multi-purpose flexibility applications, such as frequency regulation and other grid support functions. Intensium® Shift is optimized for energy time shifting of renewables, and capacity support of power systems and grids.

All container versions are standardized to deliver a consistent and holistic design that scales up to multi-megawatt systems and are ready to plug and play. They deliver:

- Enhanced safety architecture,
- High performance,
- Energy efficiency and long life in a compact footprint.

Factory assembly and testing minimizes project risk.

## Advanced Li-ion technology

- 1 LFP technology**  
Intensium Max: 120 modules of 19.2 kWh each  
Intensium Shift: 136 modules of 24 kWh each

## Thermal management

- 2** HVAC system for active and controlled air cooling and heating
- 3** Fans and ducting for even air flow
- 4** High-efficiency thermal insulation

**Advantages:** homogeneous temperature distribution across all cells and modules helps to ensure a long life as cell aging is proportional to temperature.

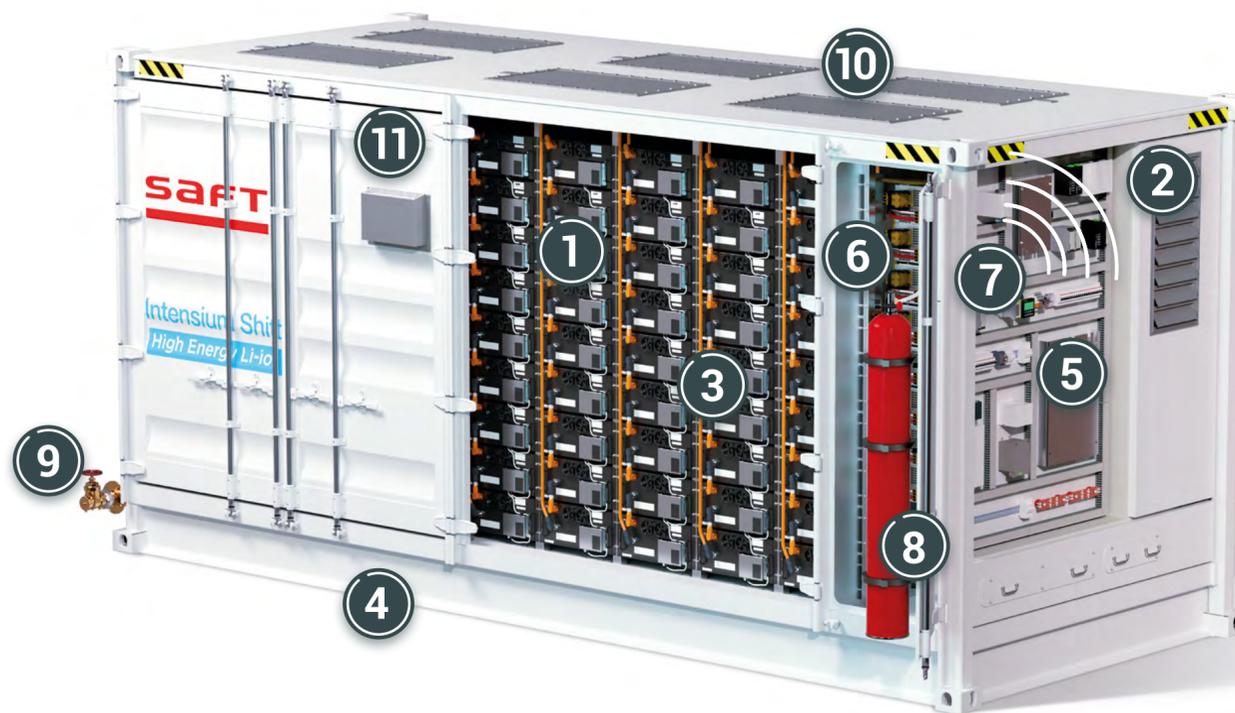
## System control

- 5** Segregated control room houses all control and communication interfaces
- 6** Battery management modules (BMMs) provide control of battery strings, modules and cells, as well as SOH and SOC management, safety and alarms
- 7** CUBE control system, Cloud-enabled, provides MESA-compliant data management

**Advantages:** consistent data management from the cell level to multiple containers is essential for large-scale ESS facilities. It supports paralleling of up to 52 strings into a single virtual battery unit. Future-proof data acquisition and management, enabling cloud-based digital twins.

## Outstanding system performance thanks to Saft's holistic design approach

- Safety
- Long life
- Energy efficiency
- High performance and availability



Intensium® Shift container, LFP 1500V

# Fully assembled and tested containers

By fully populating and testing our containers under factory-controlled conditions, our customers benefit from optimum performance, safety, minimized project risk and long lifetime.

- **Holistic design** takes account of the interaction between multiple sub-systems for optimum battery performance and lifetime.
- **Replicable** solution based on defined standards, and qualified and certified system building blocks. Supported by an optimized supply chain, as well as state-of-the-art manufacturing and quality systems.
- **Field-proven** experience from three generations of Intensium® Max containers deployed in hundreds of installations worldwide.
- **Safety-oriented** approach through in-depth risk analysis of all sub-systems and their interactions for consistent risk control and mitigation.

## Intensium® containers

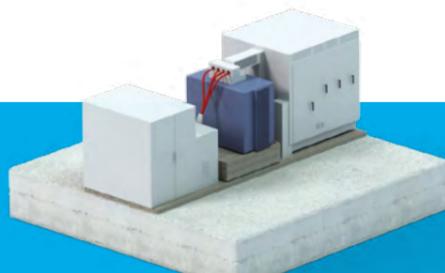
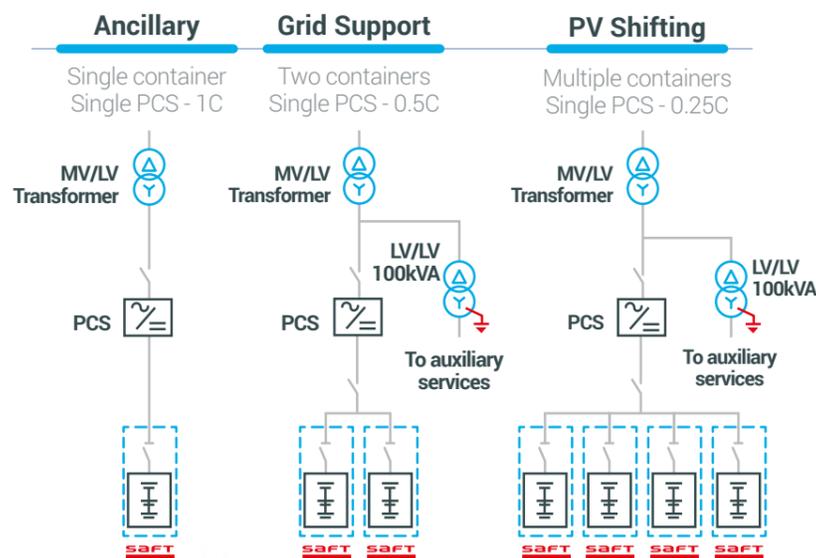
	Intensium® Max 20 High Energy 1500 V LFP	Intensium® Shift 1500 V LFP	Intensium® Shift 1500 V LFP
Discharge duration	1-2 h	2-4 h	4-8 h
Energy (kWh), nom C/5	2300	3300	3300
Continuous discharge power (kW)	1100	1620	810
Max charge/discharge power (kW)	2200	1620	810
Nominal voltage (V)	1230	1300	1300
Weight (t)	30	33.5	33.5
Dimensions L x W x H (m)	L. 6.1 x W 2.4 x H 2.9 (without HVAC)	L. 6.1 x W 2.4 x H 2.9 (HVAC included)	

# AC systems that are built around the battery

## Covering every aspect from battery to grid connection

We have built on our expertise in advanced battery technology to develop **complete fully integrated ESS solutions** that incorporate **both DC and AC** elements. We design and integrate systems, select state-of-the-art components and configure solutions operating seamlessly to match different applications, size requirements and customer needs. **Saft's AC solutions are modular and scalable**, integrating our Li-ion battery containers and proprietary in-house control algorithms with fully qualified PCS, control and protection equipment.

## Scope of supply in typical AC system configurations



### State-of-the-art Power Conversion System (PCS)

- Four-quadrant operation
- High efficiency
- Advanced control functions, such as grid-forming, black-start and islanding
- Qualification to international standards, including UL 1741 /-SA

### Modular and Versatile

Suits a variety of power and energy needs:

- Single PCS – single battery unit
- Single PCS – multiple battery units
- Multiple PCS – multiple battery units

System components and functionalities selected to optimize revenue generation for each site.

## Our ESS customers can count on

- 
**Secure revenue:** embracing the critical AC/DC interface between the battery and powerconversion, our design ensures optimal AC system availability, operability and maintainability over a long life.
- 
**Secure service:** we take total responsibility as a single point of contact for the design, supply and through-life service, supporting our customers through long-term partnership.
- 
**Secure project start:** we deliver fast, de-risked installation and commissioning thanks to standardized and robust building blocks.

### Our integration strategy

- Based on standard, pre-qualified AC and DC building blocks
- Consistent control chain from cells to massively-paralleled batteries
- Data management for a seamless interface with the customer's overall control system
  - Local and remote (cloud based)

# I-Sight Ready for the digital age

**Intensium®-Sight is Saft's integrated real-time control and supervision system for energy storage installations.**

### CUBE battery control unit

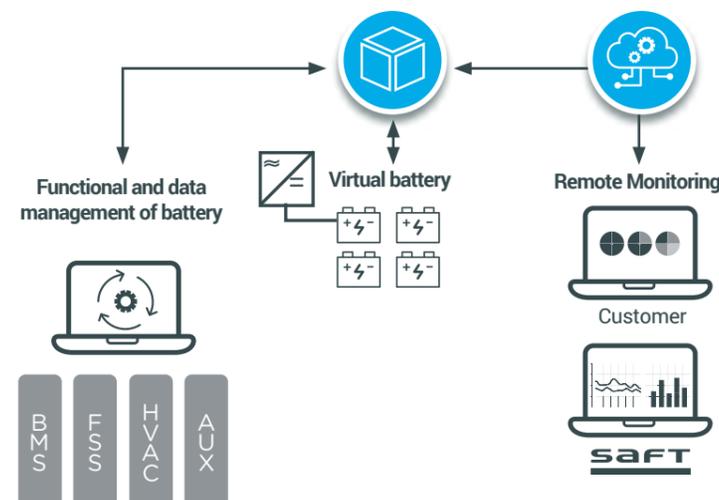
- Enables massive paralleling of battery strings into large virtual batteries
- Ensures highly granular data acquisition of all system component groups
- Local human-machine interface (HMI)

### Cloud-based data-platform

- Data storage and data processing

### User interface for operators and service personnel

- Remote monitoring and services: live data and equipment status, data recording, KPI management, troubleshooting, AI-based predictive maintenance, SOC balancing, software and parameter updates.



## Customer benefits

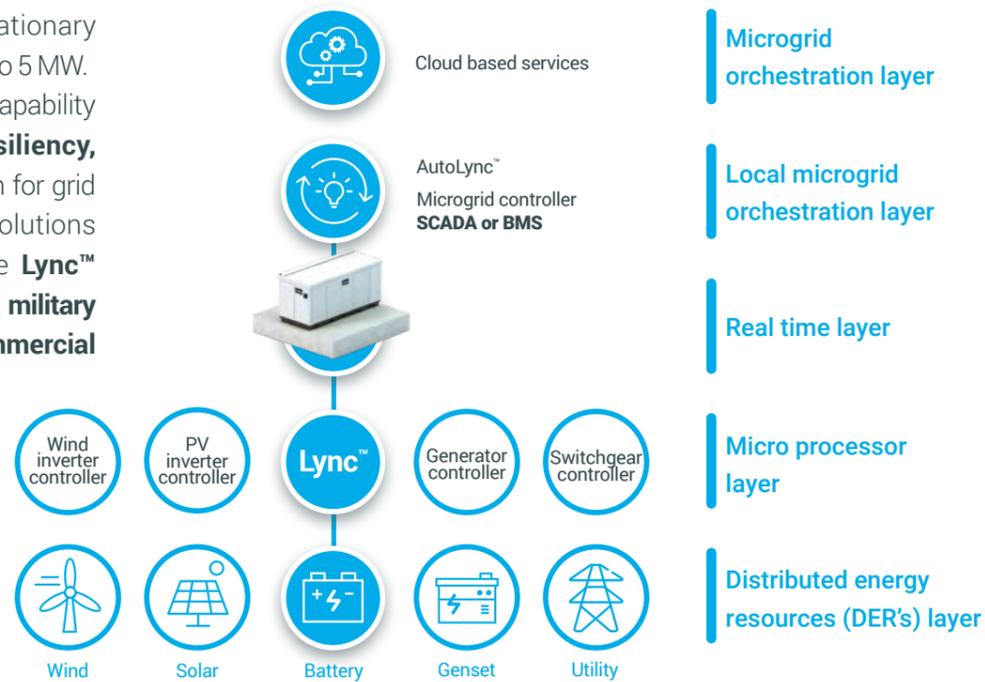
- Access to highly granular system data in real time at all system levels:**
  - Enhanced reactivity to anomalies
  - Optimized system operation and maintenance
  - Ageing prediction and anticipation of changing operation patterns
- High level of cybersecurity:**
  - Ensures data confidentiality, product integrity, availability and safety
  - Protects data, assets, people and revenue
- Supports optimized architecture for large-scale ESS:**
  - Reduced project Capex through optimum size and number of PCS
  - Straightforward interaction with the PCS through a single gateway
  - Native interoperability in energy markets

## Data management

- **Live data:** metrics of battery banks to evaluate and control the system and the operations
- **Historical data:** specific data collected during battery operation
- **Historical faults:** historic of enabled and disabled battery fault codes
- **Live auxiliary status:** status of auxiliary equipment such as fire safety system, HVAC, etc

# Blinkless resiliency for microgrids with Go Electric turnkey solutions

Go Electric customized solutions for field-deployable and stationary microgrids range from 10 kW to 5 MW. They offer unique islanding capability that provides **blinkless resiliency**, combined with utility dispatch for grid services. Our Go Electric solutions portfolio is built around the **Lync™ microgrid system for utilities, military sites, communities and commercial and industrial customers.**



Go Electric's solution controls and optimizes operation of multiple DER's and the battery. It enables a variety of grid and asset services in islanded and grid-connection mode. The system is up and running with cyber security in days (not months), leading to faster deployment resulting in lower cost.

## What **Lync™** systems can do?

### Lync™ Power Conversion Systems

- Blinkless transition from grid-connection to islanding **in less than 4 ms with no interruption in inverter output**
- Plug-and-Play: pre-programmed and pre-assembled with fused disconnects, breakers and transformer

### AutoLync™ Microgrid controller

- Automated energy management functions such as peak shaving and power factor correction
- Keeps renewables safely functioning when islanded / during grid outages
- Enables demand response services

## What **customers** can achieve with Lync™



### Reduce electricity bills

- ✓ Automated energy efficiency functions
- ✓ Maximized use of renewable generation
- ✓ Reduce fuel consumption



### Rely on uninterrupted power at all times

- ✓ From any distributed energy resource, including renewables
- ✓ Ensure critical loads and remains operating when the grid goes down



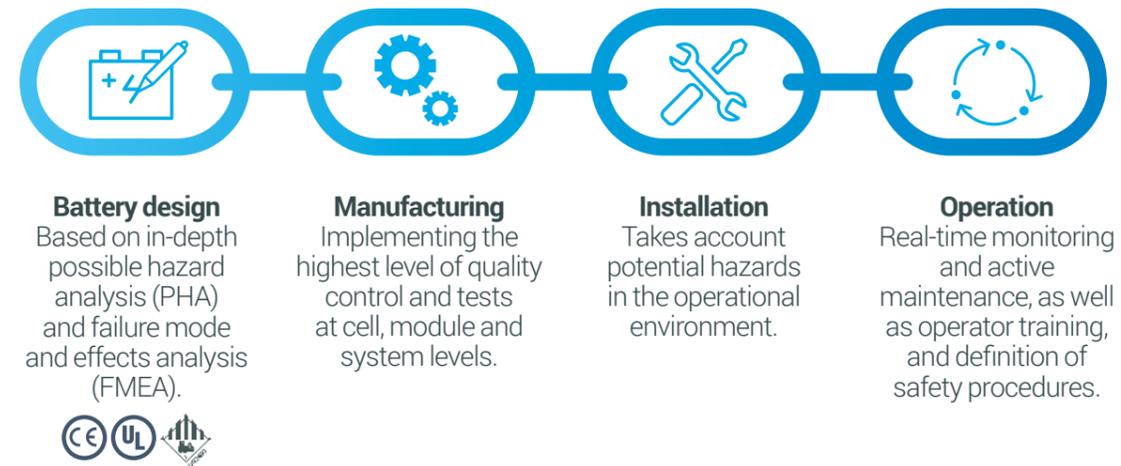
### Monetize energy assets

- ✓ Earn revenue with demand response

# Safety our number one priority

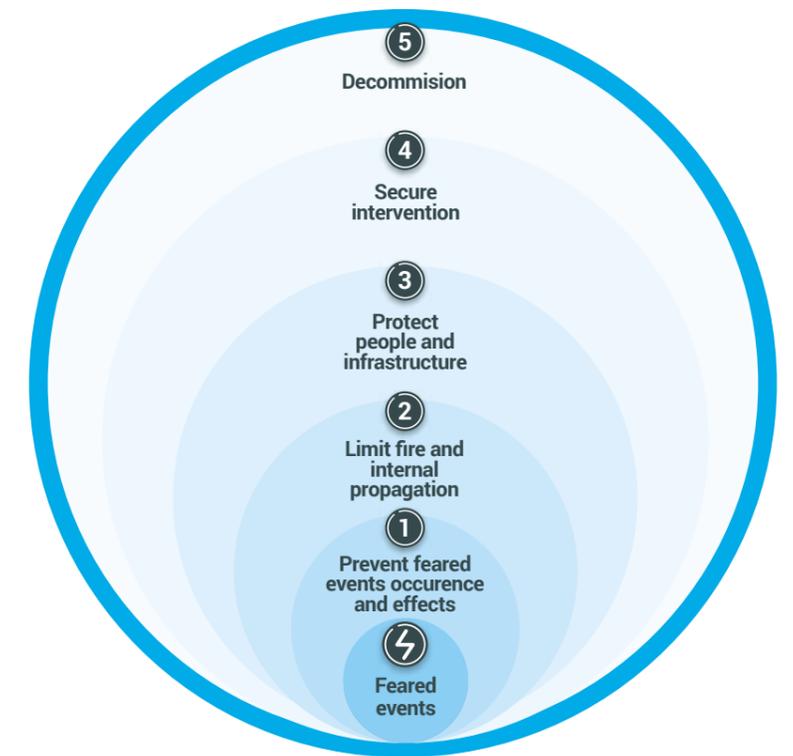
## Building a resilient safety chain that safeguards batteries from design to operation.

Safety is central to our ESS philosophy and we take a holistic approach that covers risk analysis and mitigation, testing and certification. This encompasses everything from individual components to the complete system design and operation.



# Safety at every step

Saft's ESS design is based on detailed analysis of possible risks and their consequences, as well as mitigation measures at system and environment level. The objective is to minimize risk through exhaustive testing and certification.



# World-Class Service Solutions

From full operation and maintenance to basic service support, Saft is a long-term partner that operates a **customer-centric service approach** and that has a 100-year legacy in industrial batteries. Our global **team of highly skilled and experienced professionals** delivers multi-level service solutions through our **4S program - Saft Services for Storage Systems**.

## Our 4 service packages adaptable to meet the specific customer needs.



## Our service packages

are built with the following key solutions to meet customers' needs.

- Extended warranty**  
up to 15-20 years, covering parts only or parts and labor.
- Performance guarantees**  
covering aspects such as aging, availability and round-trip efficiency.
- Services**  
training, spare parts, tooling kits, obsolescence management, upgrading and retrofitting.
- Maintenance**  
preventive and corrective maintenance, full service or support to your team.
- Remote monitoring & diagnostics**  
with Saft's digital solutions for data analytics and life cycle optimization.
- Support**  
24/7 support provided by four dedicated ESS service hubs as part of our global network of 12 regional hubs.

# Excellence in project engineering and execution

With operations in North America, Europe and Asia, **our local application engineers and project delivery teams can support your project anywhere in the world.** Our commitment to industrial excellence means that we partner you through every step from project inception and management to implementation and after-sales. We also share advice and knowledge to keep your ESS operating effectively throughout a long service life.

**Saft's dedicated ESS hubs on 3 continents guarantee excellence in project engineering, execution and service based on a continuously expanding ESS manufacturing capacity.**



A trusted partner



Discover all our projects



**Agnew Gold Mine microgrid** (Perth, Australia)  
 • Challenge: meet at least 50 percent of the mine's electricity demand from renewable energy without compromising power quality or reliability  
 • Market segment: microgrid  
 • Saft solution: Intensium® Max+20M, 13 MW / 4 MWh



**TotalEnergies Grid Services** (Dunkirk, France)  
 • Challenge: combine multiple revenue streams with evolving grid and ancillary services  
 • Market segment: grid  
 • Saft solution: Intensium® Max HE, 61 MW / 61 MWh



**Danish Fields** (Texas, USA)  
 • Challenge: manufacture and deploy 114 containers, PCS and PMS in less than one year to shift production of a 720 MWp PV plant  
 • Market segment: renewables  
 • Saft solution: Intensium® Max HE, 150 MW / 225 MWh



**Foxwell Power** (Yilan, Taiwan)  
 • Challenge: enable Foxwell Power to stack dynamic regulation services (E-dReg) and energy shifting for Taiwan's Power Corporation  
 • Market segment: grid  
 • Saft solution Intensium® Max HE, 50 MW / 173 MWh



**Microsoft Data Center**, (Stackbo, Sweden)  
 • Challenge: replace diesel generators in four microgrid subsystems on a live infrastructure site, for operation in harsh Nordic climate  
 • Market segment: C&I microgrid  
 • Saft solution: Intensium® Max HE, 12 MW / 20 MWh

We energize  
the world.  
On land,  
at sea,  
in the air  
and in space.

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**Saft, a subsidiary of TotalEnergies**  
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R.C.S. Nanterre 481 480 465

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