Totally Integrated Power – SIESTORAGE

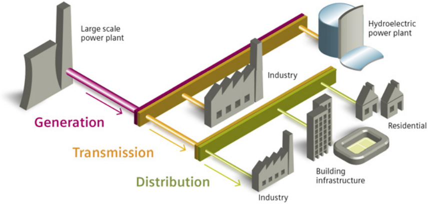
The modular energy storage system for a reliable power supply

New challenges – Our answer:
SIESTORAGE – Comprehensive competence for a reliable power supply

- Grid evolution creates new challenges
- Traditional power generation and distribution
- Modern grid:
  Integration of distributed/renewable generation
- The solution:
  The energy storage system SIESTORAGE
- Energy storage technologies
- Advantages of Li-ion batteries
- Our answer: SIESTORAGE
  Comprehensive competence to ensure a reliable power supply
- The advantages of SIESTORAGE at a glance

Grid evolution creates new challenges

Traditional grid

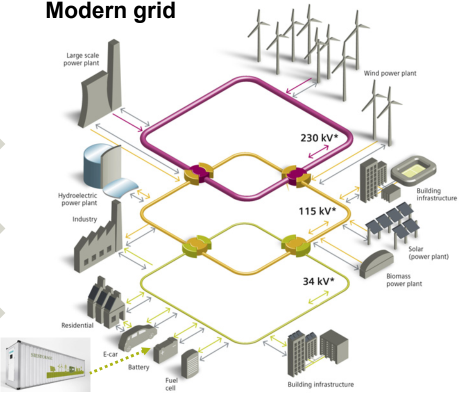

Large scale power plant
Hydroelectric power plant
Industry
Residential
Generation
Transmission
Distribution
Building infrastructure
Industry

Market deregulation

Renewable penetration

Prosumer* expansion

Modern grid

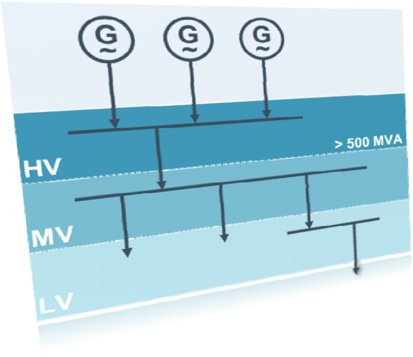

Large scale power plant
Wind power plant
230 kV*
Hydroelectric power plant
Industry
Building infrastructure
115 kV*
Solar (power plant)
Biomass power plant
34 kV*
Residential
E-car
Battery
Fuel cell
Building infrastructure
SIESTORAGE

Grid complexity increases the risk of instabilities in the grid

New stabilizing solutions are required

*contraction of producer and consumer

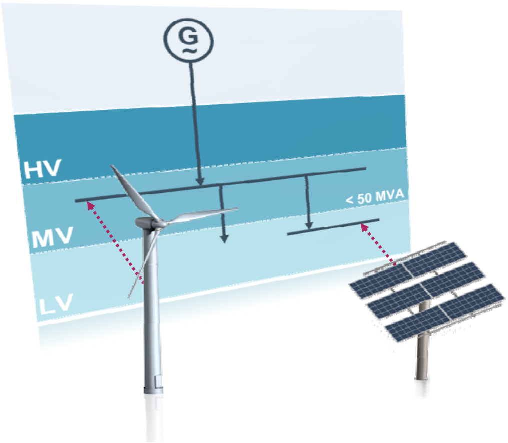
Traditional power generation and distribution



Power supply generated with conventional generators ensures the stability of the grid:

- By providing adequate short-circuit power (the available short-circuit power is an indicator for the power system stability)
- Thanks to unidirectional power flow
- Through easily adapted load requirement due to centralized generation

Modern grid: Integration of distributed/renewable generation



Generation from wind and solar leads to instability of the grid

- Fluctuation of generation (unpredictable renewable generation)
- Imbalance between generation and load
- No adequate short-circuit power available

Possible solutions:

- Grid extension
- Smart grid technology (intelligent control of grid and consumers)
- Energy storage (as a buffer against grid instability)

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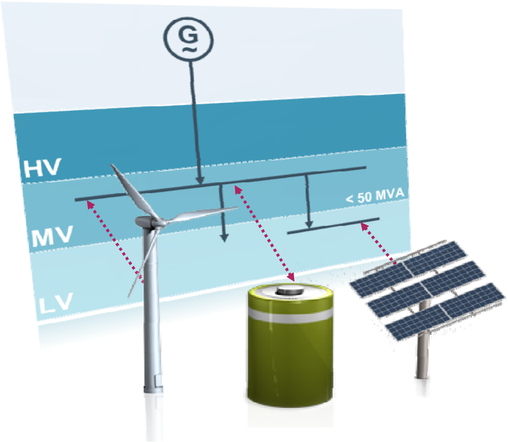
The solution: The storage system SIESTORAGE



The optimum combination of power electronics and storage system based on Li-ion batteries provides power in milliseconds for:

- Sufficient available balancing power
- Additional spinning reserve
- Active and reactive power control
- Uniformly distributed network load
- Adequate short-circuit power
- Black start

▶ Stability of the grid

▶ Power reliability / quality

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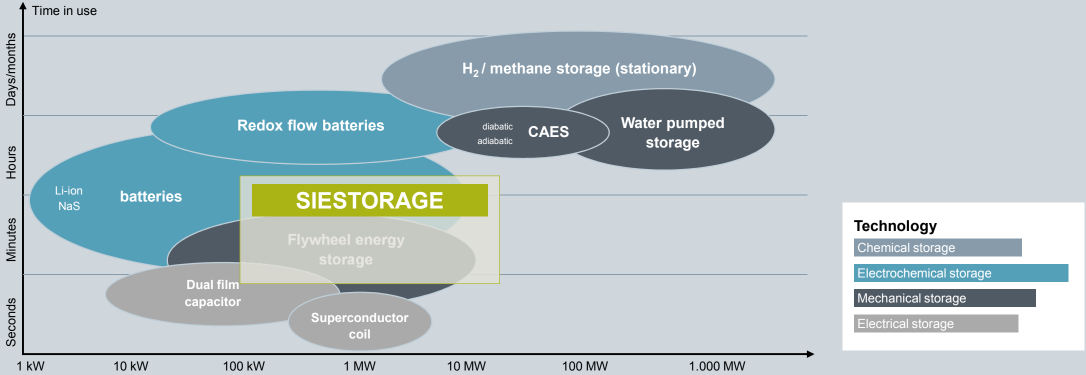
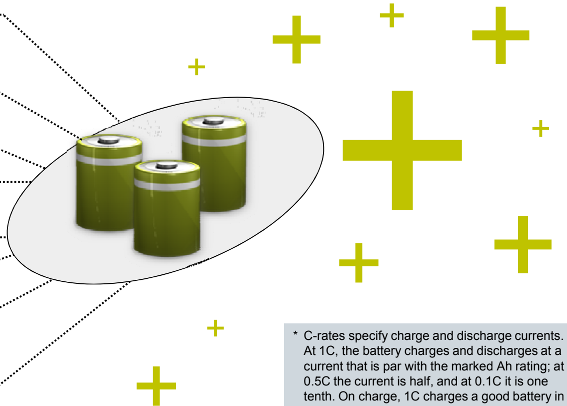
Energy storage technologies

Technologies and application areas



Source: Study by DNK/WEC „Energie für Deutschland 2011“, Bloomberg – Energy Storage technologies Q2 2011
CAES – Compressed Air Energy Storage

Advantages of Li-ion batteries



- Constant availability to charge/discharge
- High C-rate* (2-4 compared to other batteries)
- High efficiency
- Low self-discharge
- No memory effect
- Operation temperature 0 °C to 40 °C
- Very high power & energy density
- Power in/out within milliseconds

* C-rates specify charge and discharge currents. At 1C, the battery charges and discharges at a current that is par with the marked Ah rating; at 0.5C the current is half, and at 0.1C it is one tenth. On charge, 1C charges a good battery in about one hour; 0.5C takes 2 hours and 0.1C 10 to 14 hours.

Our answer: SIESTORAGE
Comprehensive competence to ensure a reliable power supply

Consistent SIESTORAGE advanced technology

Energy automation and grid integration

Medium-voltage switchgear

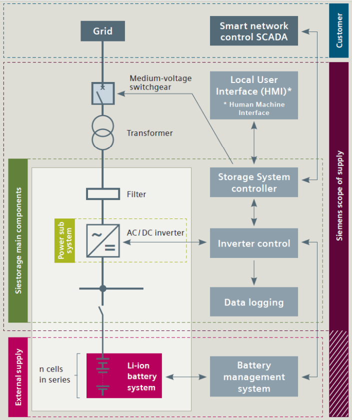
Transformer

+

Power electronics

+

Li-ion battery modules


Grid
Smart network control SCADA
Customer
Medium-voltage switchgear
Local User Interface (HMI)*
* Human Machine Interface
Transformer
Siemens scope of supply
Siestorage main components
Storage System controller
Filter
Power sub system
AC / DC inverter
Inverter control
Data logging
External supply
n cells in series
Li-ion battery system
Battery management system

+

Solution and implementation expertise

Experience with network operators

E-house manufacturing

Power packaging solution expertise

One of the leaders in smart systems

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The advantages of SIESTORAGE at a glance

- Consistency

Comprehensive energy storage, LV, MV components plus solution and implementation expertise from one hand

- One-stop-shop

From planning to after-sales service in association with global experience in project life cycle management

- Safety

Proven components, overall safety equipment and use of qualified and proven battery technology

- Reliability

Providing power supply in milliseconds and high redundancy for more availability

- Efficiency

Optimization and saving potential for your applications (e.g. spinning reserve, peak load management…)

- Flexibility

Covering all needs of storage power and capacity thanks to modular system

- Advanced technology

Storage system combining cutting-edge power electronics and Li-ion batteries

Analysis of your grid –
Saving potential with asset optimization

- Network planning and location analysis as a first step
- Applications of SIESTORAGE
- Cost analysis and asset optimization
- Application example: Spinning reserve
- Application example: Peak load management
- Application example: T&D deferral (grid relief)
- Application example: Offset diesel

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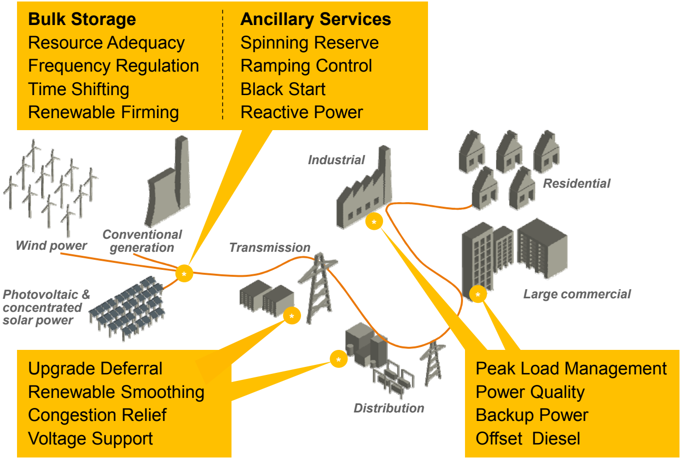
Network planning and location analysis as a first step

Reliable network planning and operation for a sustainable business model

- Power flow calculation and reactive power analysis
- Contingency analysis
- Short-circuit current calculation
- Probabilistic reliability analysis
- Dynamic stability calculation
- Protection coordination
- Economic analysis and asset management
- Workshops and trainings for the client

Applications of SIESTORAGE
Combination of various applications leads to an economic solution


Wind power
Conventional generation
Photovoltaic & concentrated solar power
Transmission
Industrial
Residential
Large commercial
Distribution

Bulk Storage
- Resource Adequacy
- Frequency Regulation
- Time Shifting
- Renewable Firming

Ancillary Services
- Spinning Reserve
- Ramping Control
- Black Start
- Reactive Power

- Upgrade Deferral
- Renewable Smoothing
- Congestion Relief
- Voltage Support

- Peak Load Management
- Power Quality
- Backup Power
- Offset Diesel

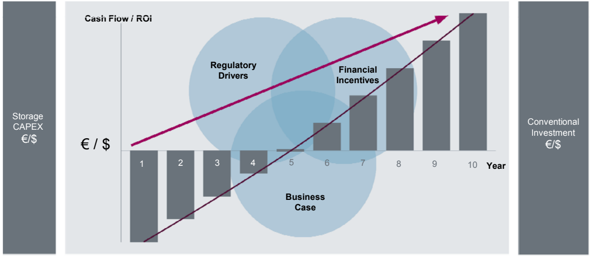
Large field of application areas for utilities, network operators, industry and infrastructure

SIESTORAGE is also suitable for:

- Supplying continuous power for sensitive industrial processes
- Energy-efficient buildings
- Isolated sites with limited power access
- Autonomous microgrids supplied with diesel genset
- Public transportation
- Electromobility

Cost analysis and asset optimization

- Cost analysis, simulation of load and generation
- Technical and financial proposal (ROI calculation)
- Business cases are also dependent on the local regulation and on financial incentives regarding the protection of environment


Storage
CAPEX
€/$
Cash Flow / ROI
€ / $
Regulatory Drivers
Financial Incentives
Business Case
1
2
3
4
5
6
7
8
9
10
Year
Conventional Investment
€/$

Saving potential with asset optimization

This depends on the application, which therefore has to be accurately assessed as the first step:

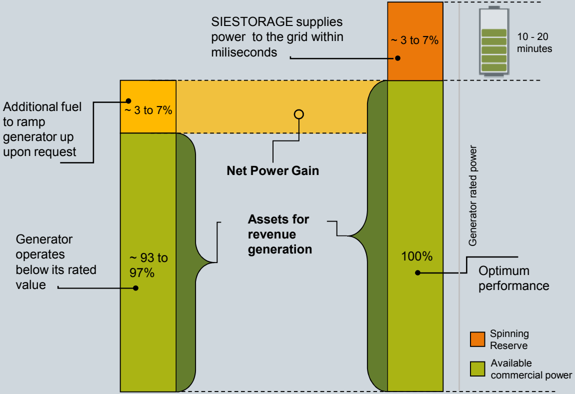
Spinning reserve (power sale)

Peak load management

T&D deferral (grid relief)

Offset-diesel optimization

Application example: Spinning reserve
Release of capped power for revenue generation



SIESTORAGE supplies power to the grid within miliseconds

~ 3 to 7%

10 - 20 minutes

Additional fuel to ramp generator up upon request

~ 3 to 7%

Net Power Gain

Assets for revenue generation

Generator rated power

Generator operates below its rated value

~ 93 to 97%

100%

Optimum performance

🟧 Spinning Reserve

🟩 Available commercial power

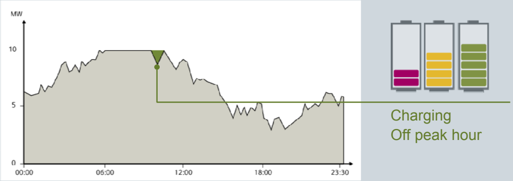
Challenges

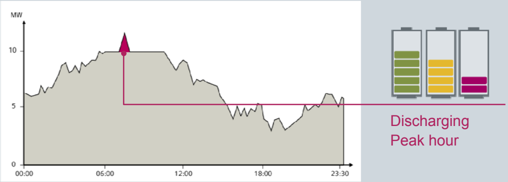
- Capacity of power plant is not always sufficient to cover the need of peak power demand
- Spinning reserve is required to maintain the system frequency (regulation)
- Generator operates below its rated value (non-optimal operation) by off peak time
- Additional fuel is necessary to ramp generator up upon request (incremental emissions and fuel consumption)

Solution and benefits

- Possibility for power plant operators to provide additional power with energy storage
- Increased system stability by providing power from SIESTORAGE to the grid within milliseconds
- Higher availability of standby power
- Assets for revenue by selling available power

Application example: Peak load management
Avoidance of incremental cost due to production peaks





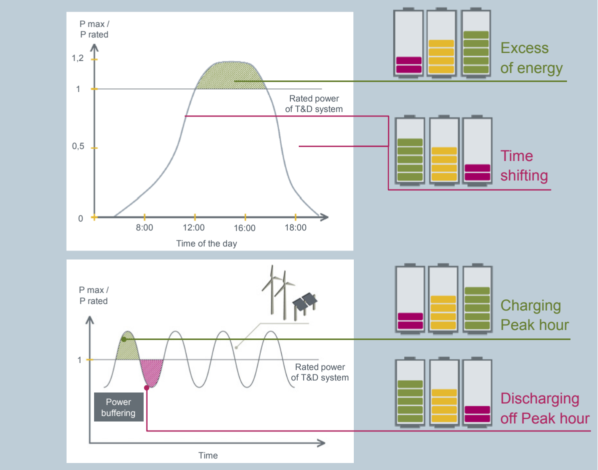
Challenges

- Need of continuous available power (Industry, network operators…)
- Volatile load curve (production peaks, time shifting…)
- Need to prevent expensive peak loads (required by the supplying utility)
- Limits of the power capacity (regulation of permitted peak loads)

Solution and benefits

- Avoiding of the major surcharge for peak power (batch processing)
- Contract of power supply with lower feedback rates
- Protection of the components (transformers, cables…) and related cost saving
- Availability of power supply 24/7 for continuous operation

Application example: T&D deferral (grid relief)
Avoidance of the capacity extension of the grid by buffering power


P max /
P rated
1,2
1
0,5
0
8:00
12:00
16:00
18:00
Time of the day
Rated power
of T&D system
Excess
of energy
Time
shifting
P max /
P rated
1
Rated power
of T&D system
Power
buffering
Time
Charging
Peak hour
Discharging
off Peak hour

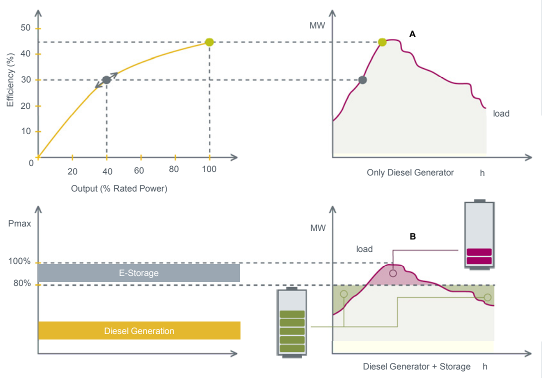
Challenges

- Volatile infeed from PV or wind generation
- Overload capacity of the power plants at certain times
- Lost of power generated by PV or wind power plant
- Grid components are not designed for distributed generation: Grid capacity extension is necessary

Solution and benefits

- Power buffering: SIESTORAGE recognizes the unplanned peak load and provides the available energy at off-peak times (low-load periods)
- Avoidance of bottlenecks in the grid
- Protection of the grid’s LV and MV components
- No expensive grid extension and reduction of the related approval procedures and costs
- Additional power buffering for fast charging stations (e.g. e-car)

Application example: Offset diesel
Improvement of the size and efficiency of gensets



Challenges

- Grids supplied only by diesel generators (island grids, isolated grids, microgrids)
- Volatile load curve of supplied areas due to integration of renewables
- No regulatory power to improve efficiency
- High diesel prices
- Large diesel generators influence the environmental footprint (high fuel consumption and gas emissions)

Solution and benefits

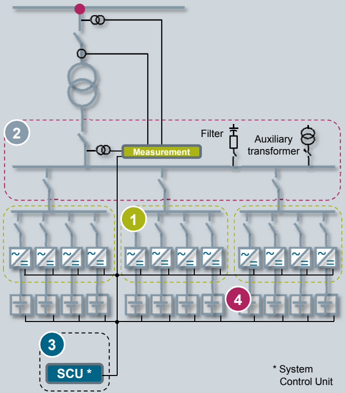
- Optimization of the size of generators (SIESTORAGE as “range-extender” to smaller gensets) to operate at higher loads
- Switch off at lower loads
- Higher efficiency of diesel generator
- Reduced run time of diesel generator
- Reduced fuel consumption and gas emissions

Implementation –
A modular concept for an effective storage solution

- SIESTORAGE modular concept
  Four components into an innovative solution
- SIESTORAGE modular concept
  Design flexibility
- SIESTORAGE modular concept
  The solution for an efficient use of the battery capacity and for more reliability

SIESTORAGE modular concept
Four components into an innovative solution

Power block arrangement


Point of interconnection (POI)
2
Filter
Auxiliary transformer
Measurement
1
4
3
SCU *
* System Control Unit

1 Inverter cabinet

(1,000 x 600 x 2,200 mm)

- 4 inverter modules and related control equipment

Each module:

- V nominal: 400 V
- I nominal: 170 A
- S nominal: 118 kVA
- P nominal: depending on the battery type

2 Grid connection cabinet

(800 x 600 x 2,200 mm)

- 400 V AC power distribution
- Switching system
- Power connection to the grid
- Filtering system
- Auxiliary transformer

3 Control cabinet

(800 x 600 x 2,200 mm)

- 1 x control unit (SCU)
- 1 x HMI (Human Machine Interface)
- 1 x Ethernet switch

4 Battery cabinet

(600 x 650 x 2,200 mm)

Content example*:

- 14 modules
- 1 BMS (Battery Management System)
- Power: 90 kW
- Energy: 45 kWh

* Depending on supplier

SIESTORAGE modular concept
Design flexibility

Flexibility to address all needs of storage power and capacity

4 Power Stacks – Content

- 1 inverter cabinet
- 1 control cabinet
- 1 grid connection cabinet
- X battery cabinets
  (max. 5 connected to one inverter module)
- Scalable to max. power of 472 kVA
- Scalable to max. capacity of 900 kWh

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12 Power Stacks – Content

- 3 inverter cabinets with
  max. 4 inverter modules
- 1 control cabinet
- 1 grid connection cabinet
  (for up to 3 inverter cabinets)
- X battery cabinets (max. 5 connected
  to one inverter module)
- Min. rated power: 1080 kW (scalable)
- Min. rated capacity: 540 kWh (scalable)

e.g. 45´containerized solution: 2x12 Power Stacks

incl. HVAC control, fire detection and extinguishing system….

- Rated power: 2160 kW
- Rated energy: 1080 kWh
- Containerized solution scalable to each power and capacity needs

SIESTORAGE modular concept
The solution for an efficient use of the battery capacity and for more reliability

Solution with parallel connection

On the DC side

- **One DC circuit-breaker** ①
- **One inverter** ②

  ▶ Single points of failure leads to low reliability of the system
- Need of additional balancing between the battery cabinets:

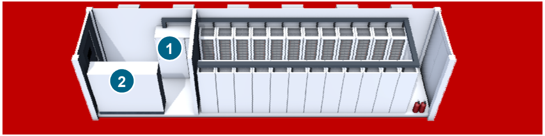
  ▶ Increased expenses and maintenance

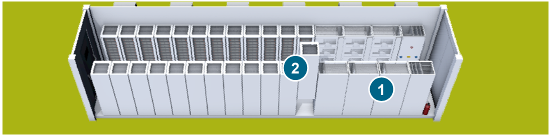
On the AC side with SIESTORAGE

- Parallel connection of the inverters on the AC-side: ①
  No synchronization between the battery cabinets
- Very high redundancy (single point of failure has no influence on the availability of the storage system)

  ▶ High availability and power reliability
- Individual balancing of battery cabinets ②

  ▶ Best use of the available energy content and installed battery capacity by lowest maintenance





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One-stop shop

- Solution from a single source
- Planning
- Engineering
- Integration into container and delivery
- Installation and commissioning
- Service –
  After sales service

Solution from a single source

We attend you within all the phases of the project, from engineering to installation and commissioning, and we ensure a reliable and competent local support – from planning to after-sales service

- Global experience in project life cycle management
- Single source from engineering to installation and commissioning
- Application expertise

Project life cycle management

Planning

Engineering

Integration into container and delivery

Installation and commissioning

Service

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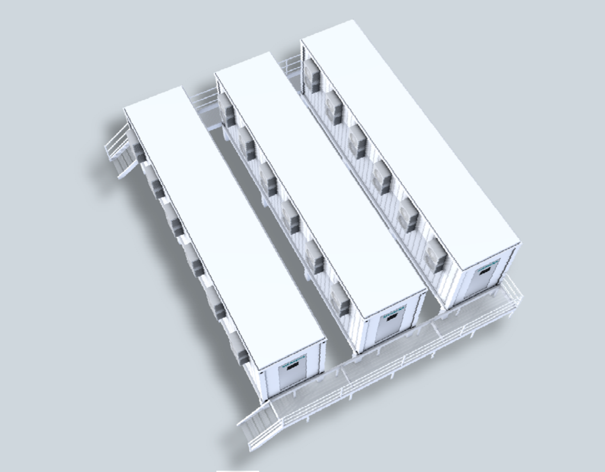
Planning

Planning as a first step

- Reliable network planning and operation
- Sustainable business model
- Efficiency optimization

Engineering



Definition of the most efficient design for your application

- Test of alternative designs
- Global sourcing
- Comprehensive range of products and systems
- Innovative and proven components
- Power management system

Components

SIESTORAGE components

Battery cabinet and battery management system

LV + MV components

HVAC*, fire fighting and safety equipment

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* Heating, Ventilation and Air Conditioning

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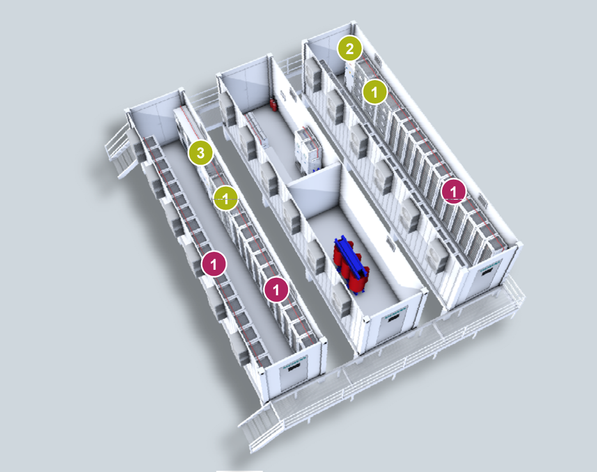
Engineering



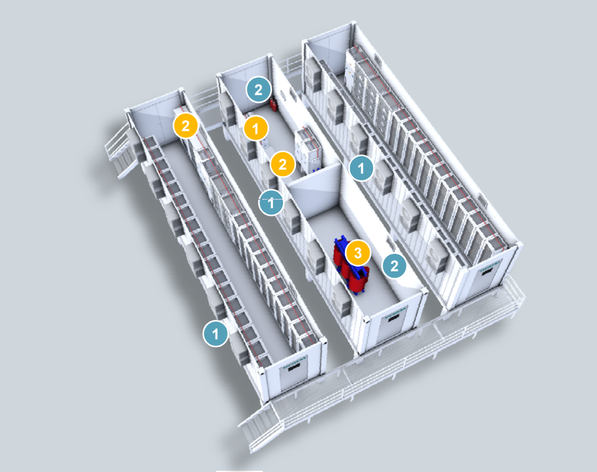
SIESTORAGE components

- Inverter cabinet ①
- Grid connection cabinet ②
- Control cabinet ③

Battery cabinets incl. battery management system

- Battery cabinet ①

Engineering



LV + MV components

- 8DJH ①
  gas-insulated medium-voltage switchgear
- SIVACON S8 ②
  low-voltage switchboard
- GEAFOL ③
  Cast-resin rectifier transformer

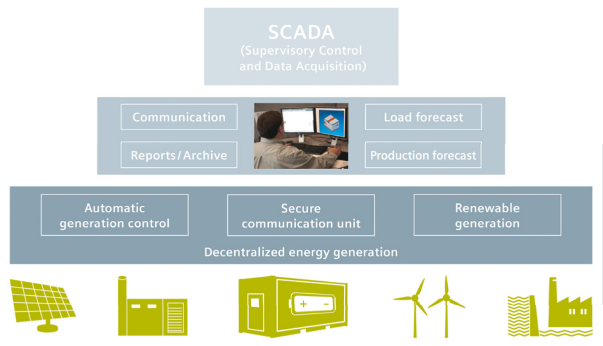
HVAC*, fire fighting and safety equipment

- HVAC ①
- Fire detection and extinguishing system ②

* Heating, Ventilation and Air Conditioning

For more information please check out the PDF under the following link: interactive datasheet SIESTORAGE

Engineering


SCADA
(Supervisory Control
and Data Acquisition)
Communication
Load forecast
Reports/Archive
Production forecast
Automatic
generation control
Secure
communication unit
Renewable
generation
Decentralized energy generation
+
–

Power management system including renewable energy generation and SIESTORAGE

- Standardized communication interfaces for connection with your SCADA system
- Analysis and improvement of energy efficiency
- Remotely controlled equipment
- View of all equipment in real time
- More transparency (e.g. energy mix) thanks to operational data
- Possibility to create a virtual power plant

Integration into container and delivery

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Possibility of integration into prefabricated container (e.g 45´) or existing building

- Integration from one hand
- E-House manufacturing
- Power packaging solution expertise: MV equipment (switchgear, transformers…), utilities access control, HVAC, fire detection and extinguishing system
- Delivery
- Ready to install: completely developed, manufactured, assembled and pre-tested

Installation and commissioning

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SIESTORAGE installation at the grid of ENEL (Italy´s largest energy supplier) – Installation and commissioning 2012 – 1MVA/500 kWh

Installation, connection and commissioning on site

- Reduced construction risks and reduced installation time
- Power supply solution including substation equipment (transformers…)
- Energy automation and integration into the grid

Contact page

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