BASF
We create chemistry

NAS® Battery for Stationary Energy Storage

High-energy, long-duration sodium-sulfur battery

NAS®
Sodium Sulfur Battery

Produced by NGK INSULATORS, LTD.
Distributed by BASF

Global demand for power generated from renewable sources, such as wind or solar, is growing. Stationary energy storage is one of the key technologies to ensure reliable power supply despite the intermittent nature of these sources as it can store excess energy and discharge it at time of peak demand.

Power supply

Grid services

Energy consumers

BASF is selling NAS® Batteries

The batteries come with a 10-year performance guarantee*.

The team at BASF Stationary Energy Storage helps you find the right solution: We conduct an initial cost-benefit analysis for your project, deliver the layout of the batteries and provide further advisory support, if needed. Our worldwide presence ensures we can respond to your requests in a timely manner.

* subject to contract conditions

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NAS® Battery: designed for stationary storage

With their capacity of 1.45 MWh and discharge duration of 6–8 hours, NAS® batteries are best suited for long-duration stationary storage applications. They boast many superior features:

- Long duration
- Long lifetime
- Safe & reliable
- Environmentally benign
- High energy density
- Fast response
- Climate resilient
- Low maintenance

Applications

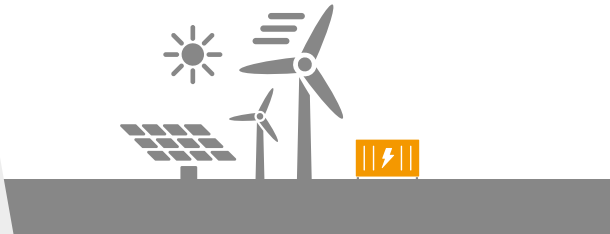
NAS® batteries play an important role all along power grids as well as in off-grid applications. They offer benefits to various segments of the energy market.

Power supply

Renewable stabilization
Fluctuations of renewable energy are leveled out by absorbing excess energy during off-peak times and providing additional power during demand peaks.

Fossil fuel peaker plants replacement
NAS® batteries provide resource capacity of six hours or more per day and thus can serve as a green alternative to fossil fuel peaker plants.

Other use cases
On-peak/off-peak price arbitrage, frequency regulation, ramping services, VAR support and other grid functions.



Grid services

Investment deferral
Transmission and distribution upgrades can be deferred or even eliminated by deploying NAS® batteries. They can store excess energy during the light load times and discharge it when the demand is high.

Ancillary services
Thanks to their fast response, NAS® batteries can reduce imbalances between demand and supply to stabilize the grid.

Energy consumers

Peak shaving
Reduce demand charges by covering peak energy demand with an NAS® battery: The battery is charged at a low demand time and discharged during peak time, supplementing power supply from the grid.

Time of use shift
Costs of power supply from the grid can be reduced by storing energy and shifting its usage from high-tariff times to low-tariff times.

Backup power and resilience
Continuous power for six hours or more in the event of grid outages.

Demand response
Supply-demand balance is maintained by aggregation and redistribution of unused power from multiple consumers for effective utilization of power resources and cost optimization.
→ **virtual power plant**

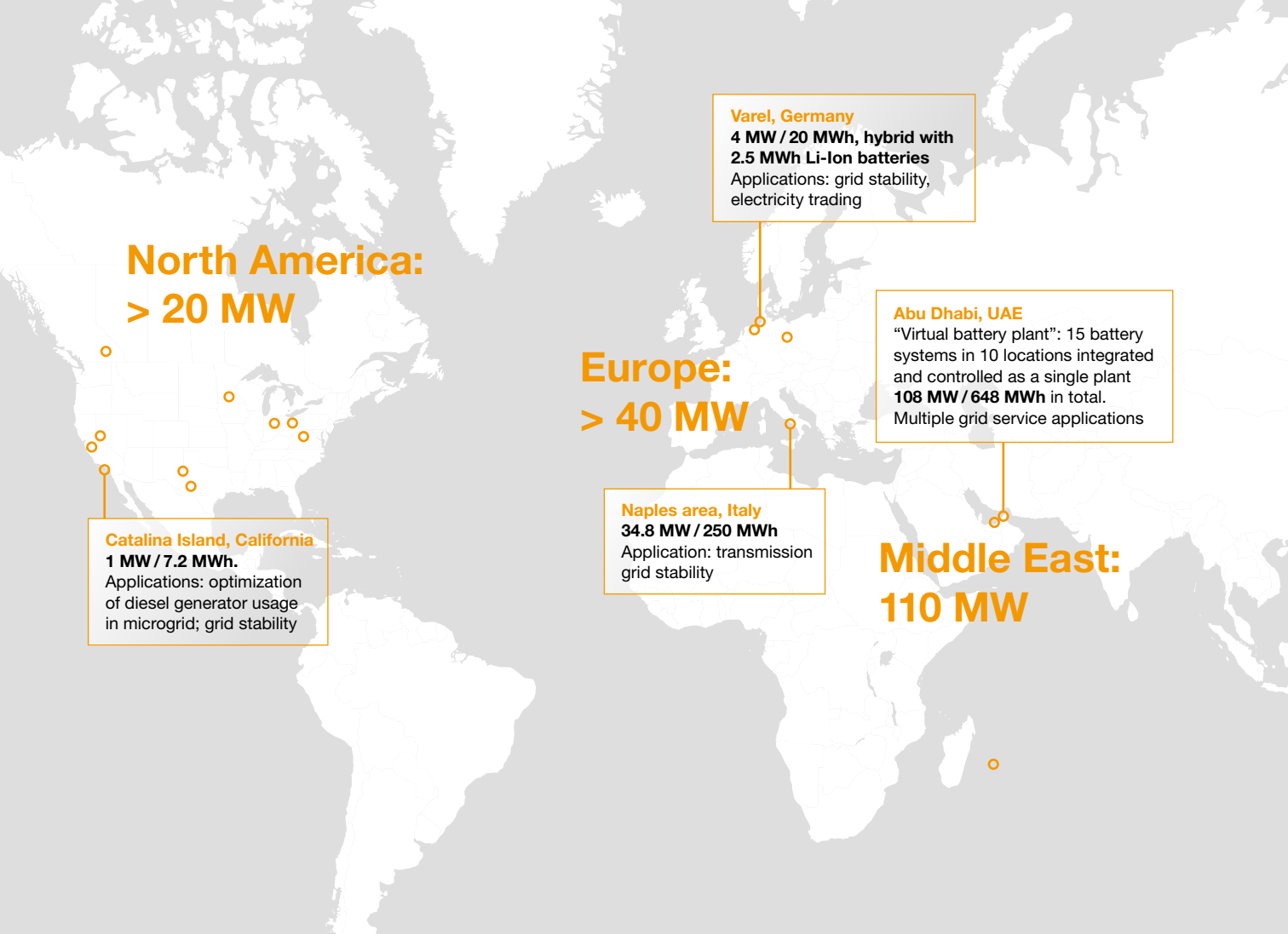
Microgrids

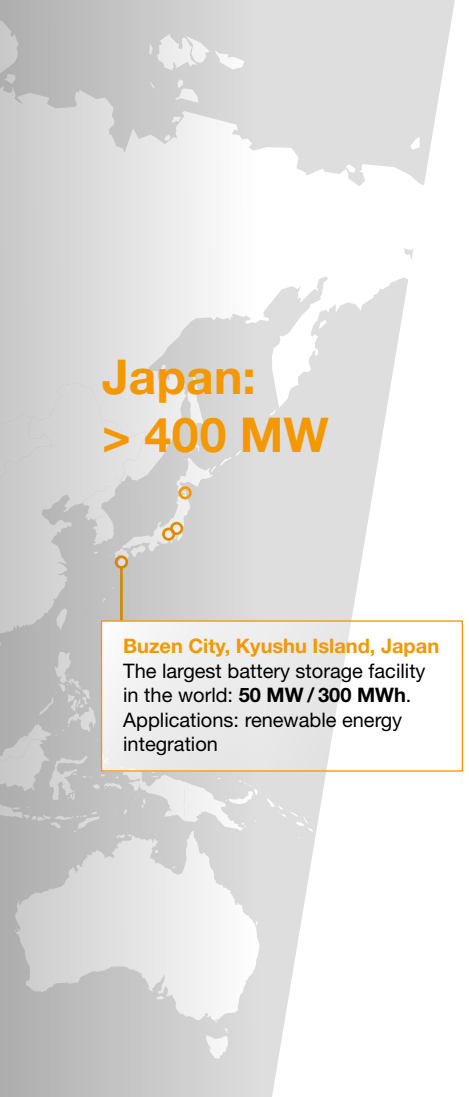
Reliable power supply from renewable sources
Combine solar or wind power generation with an NAS® battery to achieve reliable power supply and optimize energy costs.

Autonomous power supply with solar power
Excess solar power is stored by an NAS® battery in the daytime and used at night time. Power supply from grid is thus reduced or even eliminated.

Minimization of fossil fuel use
Reduce energy costs and CO_2 emission by combining an NAS® battery with a diesel or biomass generator.

Additional resilience to local power generation


North America:
> 20 MW
Catalina Island, California
1 MW / 7.2 MWh.
Applications: optimization of diesel generator usage in microgrid; grid stability
Europe:
> 40 MW
Varel, Germany
4 MW / 20 MWh, hybrid with 2.5 MWh Li-Ion batteries
Applications: grid stability, electricity trading
Naples area, Italy
34.8 MW / 250 MWh
Application: transmission grid stability
Abu Dhabi, UAE
"Virtual battery plant": 15 battery systems in 10 locations integrated and controlled as a single plant
108 MW / 648 MWh in total.
Multiple grid service applications
Middle East:
110 MW

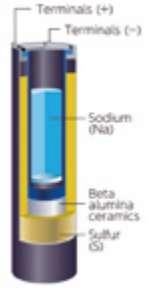


#1 choice worldwide for large-capacity energy storage

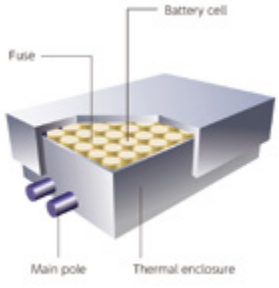
NAS® Battery technology has been proven by more than 20 years of deployment at customer sites all around the world. During this time, more than 250 projects have been implemented, with a total output exceeding 720 MW and 5 GWh.

NAS® Battery Technology

A containerized NAS® battery is made up of six modules with 192 cells each. The NAS® Battery cell consists of sodium as the negative electrode and sulfur as the positive one. A beta-alumina ceramic tube functions as electrolyte, which allows only sodium ions to pass through. When discharging, sodium is oxidized and sulfur is reduced to form polysulfide (Na_2S_x). The charging step recovers again metallic sodium and elemental sulfur.



Battery Cell



Battery Module

Battery Container

Technical Specifications

We supply containerized NAS® batteries. The compact form enables easy transportation and quick installation at a customer site. A single container features 250 kW (peak power) / 1.45 MWh. By stacking containers, the total energy of the system can be easily scaled up to any required amount.

Max. Discharge Power [kW-DC]		250	500	750	1000
Energy Capacity [kWh]		1,450	2,900	4,350	5,800
Weight [t]		21	42	63	84
Numbers of Containerized NAS Batteries Connected in Series		1	2	3	4
DC Nominal Voltage [V]		192	384	576	768
Footprint	Width x Depth Area	6.1 x 2.4 [m] 15 [m²]	6.1 x 2.4 [m] 15 [m²]	6.1 x 5.6 [m] 34 [m²]	6.1 x 5.6 [m] 34 [m²]
	Assumed Arrangement				

Safety Aspects

In designing the NAS® Battery, safety has been of paramount importance.

Proven safety
The safety of NAS® batteries has been proven by NGK and the Japanese Hazardous Material Safety Techniques Association (HMSTA / KHK).

Additionally, a safety audit has been carried out by TÜV Rheinland.

NAS® Battery cells and modules are certified as recognized components to UL 1973 standard.

NAS® Battery cells and modules have been evaluated using UL 9540A

NAS® batteries comply with CE marking requirements

Expected lifetime
20 years or 7,300 cycles (at 100% DoD or equivalent), whichever occurs first.

Environmental impact
NAS® battery cells are hermetically sealed and there is no emission during operation.

Warranty
Two-year manufacturer warranty. Performance guarantee for 10 years* provided by BASF.

Test: **Put module in fire**

Result: No leakage. No fire.
Safety confirmed.

Test: **Submerge module at operational temperature**

Result: No leakage. No fire.
Safety confirmed.

Test: **Drop module at operational temperature**

Result: Module enclosure was damaged but no damage to battery cells.
No leakage. No fire. Safety confirmed.

Test: **Short circuit module**

Result: Circuit was opened by internal fuses. No leakage. No fire.
Safety confirmed.

Test: **Ignite one battery cell inside module**

Result: No expansion of fire to adjacent battery cells = no thermal runaway.
No leakage. No fire. Safety confirmed.

Installation process

NAS® batteries have a plug-and-play design that enables integration of the battery and control equipment in one container. Containerized NAS® batteries can be easily transported and quickly installed. Several containers can be integrated into larger systems.

Operation and maintenance

Appropriate maintenance is recommended to ensure stable operation for a battery lifetime.

Routine check

- Visual inspection
- No need for suspending operation

Periodic check (fee-based service)

- Every four years
- Replacement of consumable parts
- Functional tests

- 24/7 remote monitoring of customer's system
- Technical support via phone or email

* subject to contract conditions

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To find out more about NAS® batteries, please contact us:

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