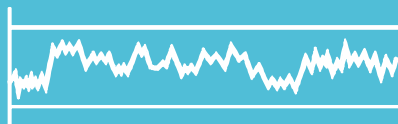


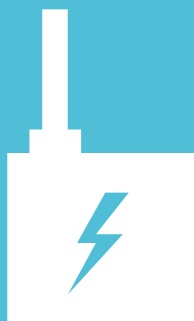
Enhancing Gas Turbine Power Generation with Battery storage

SIESTART Hybrid solution for more flexibility

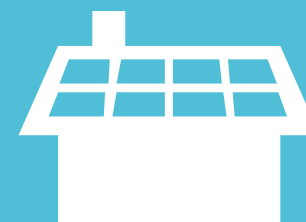
Current challenges in the grid



Higher utilization of renewables and less rotational inertia from conventional power generation units



Stability of the grid and secure supply of power



Higher flexibility and shorter reaction times requirements to the producers

Power producers have to broaden their capabilities

ensure **grid stability** as the power system operation is under threat



Conventional power plants (heavy duty as well as industrial scale) need:

- Accelerated load ramping for fast compensation of unbalances in the grid
- Spinning reserve as additional power reserve to stabilize the grid
- Islanding and off-grid services (especially for industrial power plants)
- Black start capability in the case of a grid failure

Our answer: SIESTART - A hybrid power generation solution

Siemens Gas Turbines

Li-ion Battery Storage (SIESTORAGE)



Combining the performance of a gas turbine with the fast and reliably responding battery storage system

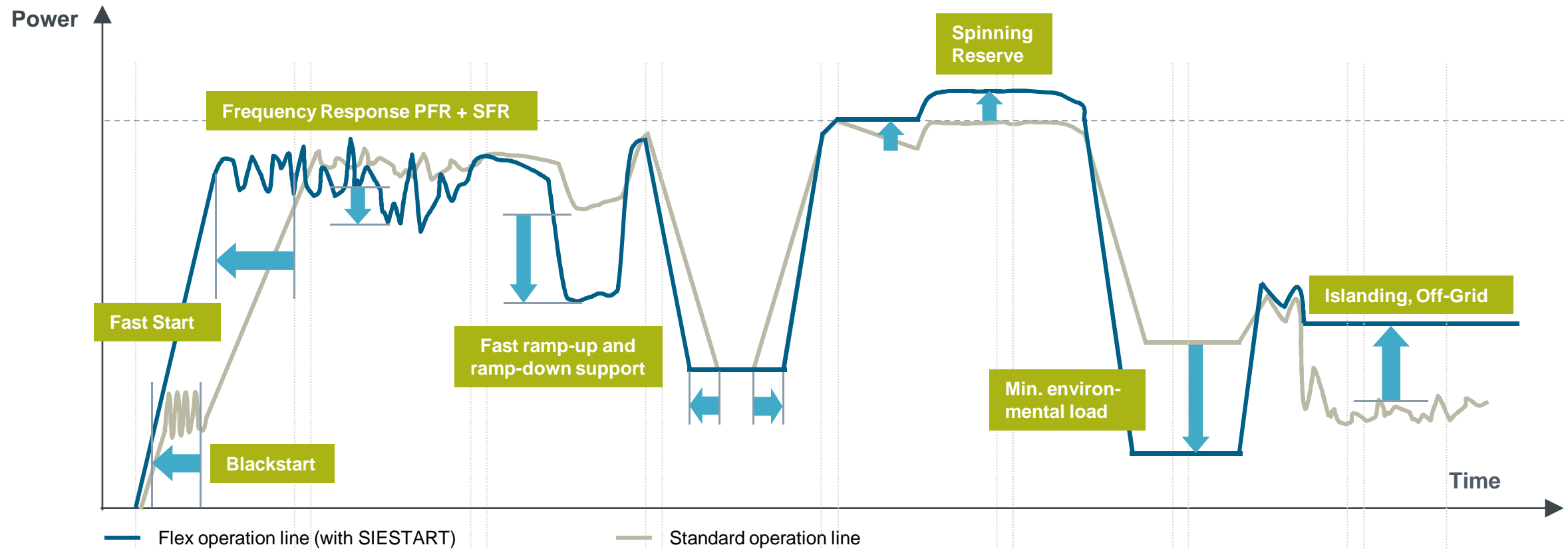
Retrofit of existing power plants

Optimized OPEX

Added value for new installations

SIESTART: optimized performance and new opportunities – for Grid Services and Gas Turbine Operation

SIEMENS



Blackstart and support of grid restorage

Fast Start Up

Primary Frequency Response

Secondary Frequency Response

Acceleration & stabilization of load ramps

Operating reserve for peak power

Minimum load

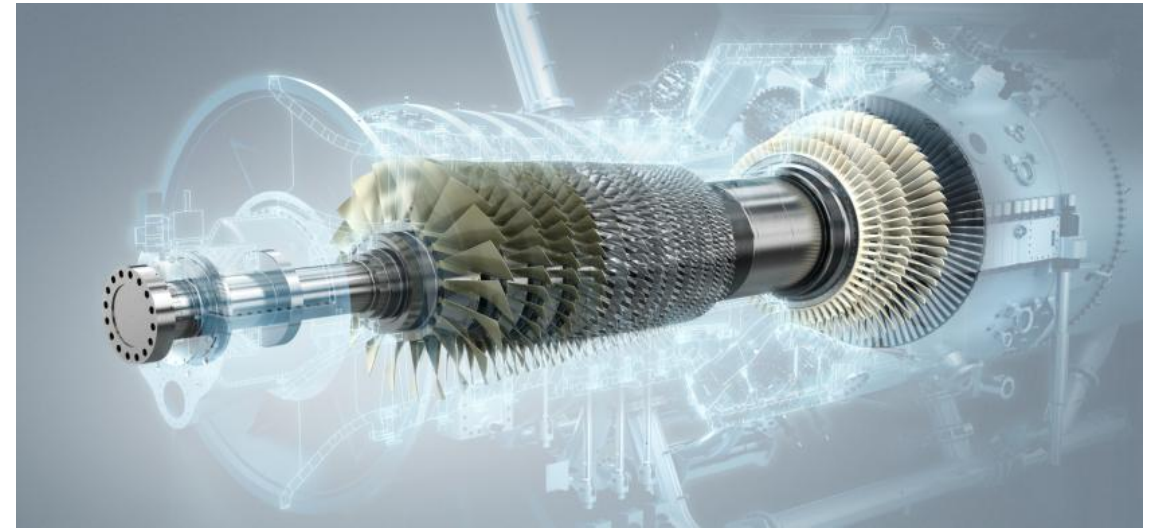
Islanding off-Grid

SIESTART: Enhancing gas turbine operation with SIESTORAGE

SIEMENS

Use cases:

- Black start
- Grid restorage
- Frequency control
- Stabilization of voltage - Critical power
- Stabilization of electrical island mode
- Ramping control and acceleration
- Decrease GT minimum load by time shifting
- Spinning reserve



Example at VEO (Vulkan Energie Oderbrücke GmbH), Eisenhüttenstadt, The steel plant operation depends on black start capability

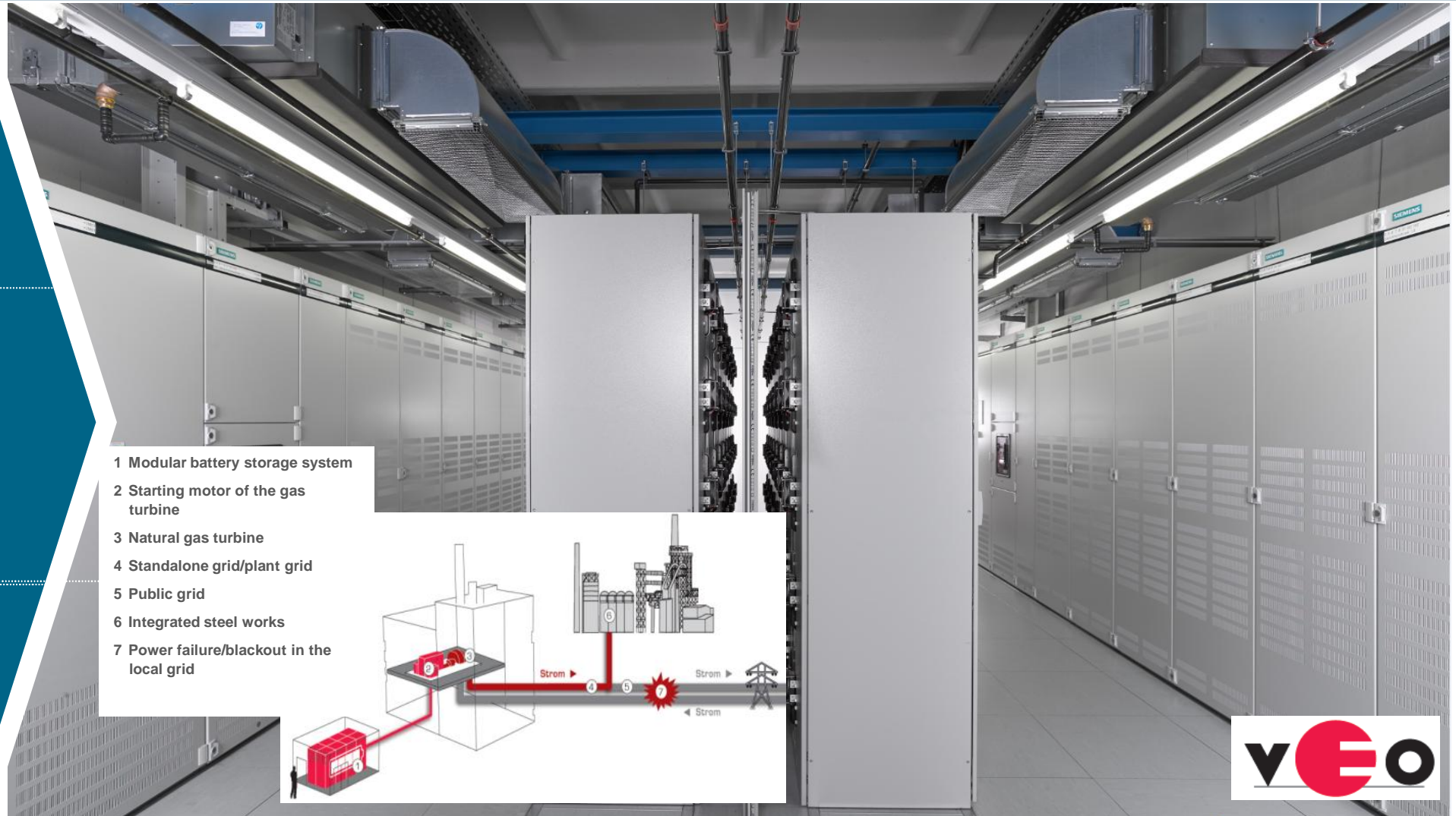
SIEMENS

2,8 MW/
1080 kWh
SIESTORAGE system

Main applications

Black start
of a gas turbine

Turnkey solution



Siemens: your trusted partner for world-class energy products and solutions – with more than 130 years of experience and expertise in power generation

SIEMENS

Cutting-edge technological portfolio

- Gas Turbines from 5 to 425 MW
- Steam Turbines from
- Generators
- Electrical components
- I&C solutions for all types of plants
- Modular battery storage concept
- Turnkey industrial or heavy-duty power plant solutions (simple cycle, combined cycle, cogeneration) from 14 MW to 1,250 MW

Comprehensive portfolio of expertise and know-how

- Consulting
- Project development
- Financing
- Engineering
- Procurement
- Construction
- Commissioning
- Optimization
- Operation & Maintenance
- Service & Retrofit

Proven experience all over the world

- > 600 GW capacity installed since 1960
- > 25,000 Siemens gas and steam turbines in commercial operation
- > 6,000 power plants equipped with Siemens turbines
- 20 battery storage projects in eight regions for seven use cases
- > 2,700 power plant projects with Siemens I&C
- Track record in health & safety

Holistic one-stop-shop for the entire life-cycle of your power plant solutions!

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