ENGINEERING
TOMORROW

Danfoss

Hybridization
– perfectly balancing **supply**
and **demand**

POWER
Exactly when
you need it

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Improve performance by making better use of energy

The world is steadily, and quite quickly, diversifying its primary sources of energy. As we transition from fossil fuels, such as oil and coal, through natural gasses and nuclear power and further toward solar, wind and hydro, there's an increasing need to overcome the gaps produced when the scales of energy supply and demand are out of balance.

Energy providers attempt to meet the ever-changing supply and demand requirements as closely as possible. However, external factors, such as the weather (in relation to renewable sources of power) and the needs of industrial customers (with inherent changes in peak demands), make the attempts to predict the requirements quite challenging. This is where hybridization comes into play.

Hybridization at a glance

A simple and broad definition of hybridization is any system with two or more sources of energy acting together to accomplish a task. Perhaps the most commonly recognized form of hybridization today is a hybrid vehicle where a conventional internal combustion engine is combined with an electric system to create a 'hybrid' power train. The benefits of hybridization, in this instance, are fuel savings, performance improvements and reduced emissions.

In the world according to Danfoss Drives, the definition of hybridization can be summed up by introducing a means of energy storage into a system. Hybrid solutions are implemented primarily for at least one of three reasons:

- Reduce or defer capital expenses (CAPEX)
  - avoid over-dimensioning a system
  - defer investment in infrastructure

In over-supply situations, the hybrid system can store the surplus energy. When demand levels are high, the stored energy can then be used again to provide an additional source of energy;

- Reduce operating expenses (OPEX)
  - improve system efficiency
  - increase system availability

Hybrid systems can increase system efficiency and avoid power outages caused by grid instability;

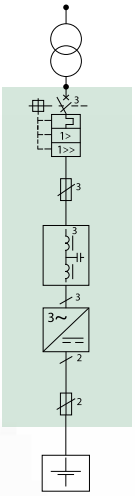
- Decrease downtime of the system by increasing robustness in the case of power-quality issues.

Hybrid configurations

To the right are illustrations of how some of these systems can be arranged. The size and layout of each hybrid system varies greatly depending on the application.

Energy storage directly connected to the AC grid using a grid converter

This reduces the component count and size of the system and improves efficiency.



Danfoss Drives products for hybridization can be utilized in many applications

Challenge	Benefit
Integration of renewable energy sources	• Energy production forecasting • Peak shaving • Time shift of production
Grid stability – ancillary services	• Frequency regulation/inertia emulation • Spinning reserves • Overload ability/boosting • Fast starting/reacting
µGrids	• Peak power compensation on a substation-level • Back-up power in disturbance situations
Efficiency	• Energy production optimization in co-operation with diesel and LNG generators • Consumption optimization of loads in marine environment • Avoid transmission losses
Ecology	• Clean energy in harbors • Time shift, integration of renewable power supplies
Availability of electrical power	• Uninterrupted power supply to, for example, telecommunications, airports and hospitals
Land construction and mining	• Local energy production, typically diesel gensets, operation optimization with batteries • Machine hybridization

Danfoss Drives hybrid solutions

Energy storage is often described as a key enabler for integrating renewable energy into power generation. However, Danfoss is widening the scope of energy storage and developing solutions that also focus on the optimization of energy consumption. By equipping both machines and entire processes with energy storage systems, it is possible to significantly improve power quality and upgrade performance and overall efficiency.

Key benefits of energy storage

Energy storage provides greater stability in power production systems by applying peak shaving to the incoming power, time shift for production and back-up power in emergency situations.

Peak shaving

Peak shaving involves optimizing the energy flow between the incoming supply and local storage to meet spikes in demand. Excess energy can be stored when demand and costs are low.

Time shifting

Time shifting involves storing energy during times when energy costs from the grid are low, and supplying energy from the storage medium when energy costs from the grid are high

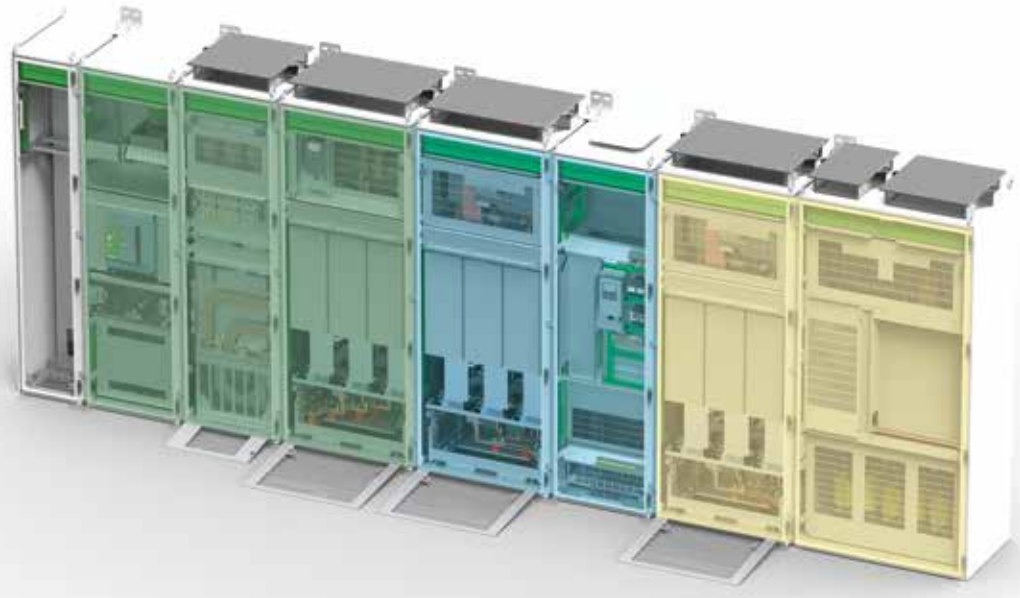
Back-up power

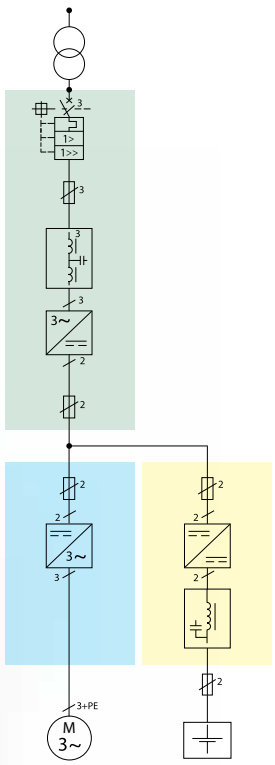
Energy storage can be used to provide back-up power during outages maintaining the ability to operate for a period of time.

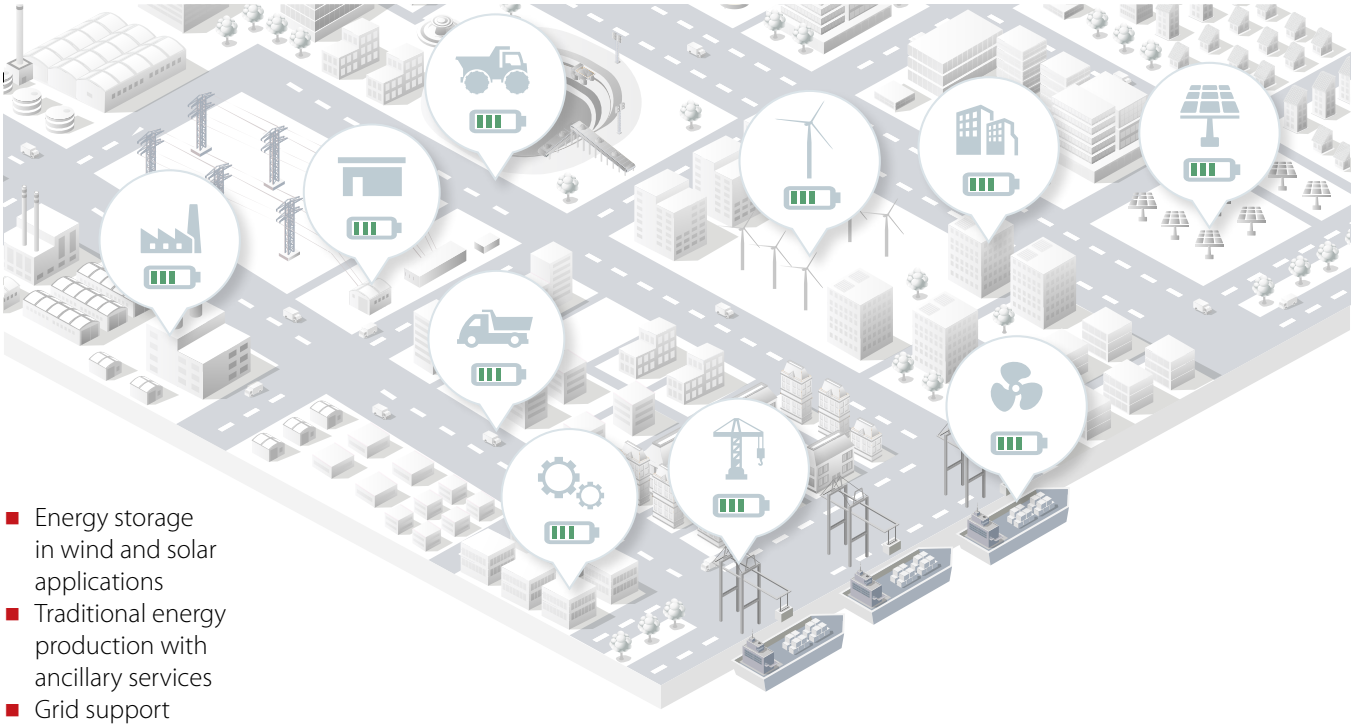
Hybridi system utilization is expected to continue to increase significantly across a wide cross section of land- and sea-based industry and commercial sectors, especially due to the reduction of battery costs and increases in energy density.

DC/DC converter connected between the DC link and the energy storage

This brings the load power/energy support close to the consumption, provides different storage voltage/technology adaptations, increases expandability and enables the battery stack to be replaced as needed.







- Energy storage in wind and solar applications
- Traditional energy production with ancillary services
- Grid support
- Marine and Off shore industry
- Harbors
- Machinery-level energy storage
- Land construction and mining

Features and benefits of the Danfoss hybrid solutions

Feature	Benefit
One stop shop	Reduce procurement costs – Air- and liquid-cooled drives, AFE, NFE, DC/DC, Grid Converter, DC Modules and components are available from one source
Wide power range	Reduce variants – solutions are available for applications in a kW to MW range
Modular solution	Based on the VACON® NXP platform power modules, the DC bus system can be easily configured
Wide voltage range	Increase flexibility – Ability to integrate a wide variety of common battery bank voltages using a DC/DC converter
Flexibility	Easy to upgrade – The simple-to-extend VACON® NXP platform provides great system flexibility with a low additional investment
Scalability	Solutions can be scaled up to meet future energy requirements in terms of new energy sources, additional storage or to meet increasing demand
Serviceability	Lower investments – Utilizing the same VACON® NXP hardware configurations, service teams require little to no additional training
Industry and application knowledge	Made to last – Liquid- and air-cooled solutions based on in-depth application knowledge for the most demanding industries
Open approach	Faster Go-To-Market – Wide range of applications made available as foundation for building tailored solutions
Partnership	Stronger together – System integrators collaborate with a vendor who has a vested interest in their success

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