SIEMENS energy

Hybrid controls for wind power

Omnivise portfolio



With our Omnivise Hybrid Control (OHC), we integrate different technologies to make sure, that all components in your hybrid plant interact perfectly.



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1. Hybrid systems take center stage in wind power generation

As the global community faces the pressing challenge of climate change, hybrid renewable energy plants – combining wind and other renewables – are emerging as a crucial solution. These systems not only enhance the stability and reliability of power generation but also play a vital role in reducing carbon emissions and improving energy security.

Countries around the world are increasingly recognizing the advantages of hybridization, **adapting their grid regulations** to promote the integration of diverse energy sources. This evolution is characterized by the deployment of advanced technologies that enable enhanced grid services, such as **black start capabilities and ancillary services**, while optimizing generation schedules through integrated energy management systems. The complementary nature of hybrid systems allows for increased energy generation and **diversification of energy sources**, thereby reducing reliance on any single source and mitigating risks associated with revenue volatility.

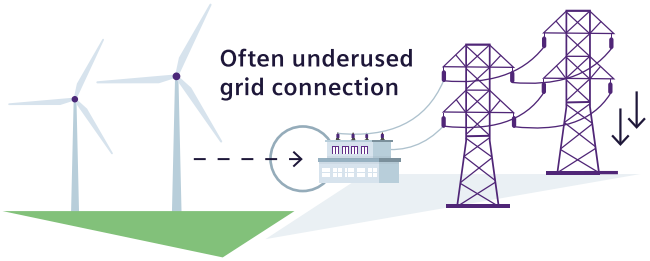
As the renewable energy landscape continues to evolve, the potential for hybrid wind power systems to reshape energy generation is becoming increasingly evident. Embracing hybridization in wind power generation is more than a strategic move; it is a necessary step towards a sustainable energy future.

Omnivise T3000 enables plant operators to combine renewables with other solutions that eliminate their weak points – meaning, it is specifically designed to integrate various energy sources seamlessy. **Omnivise Hybrid Control (OHC)** enables operators to guarantee grid code compliance within a hybrid plant.

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Current situation

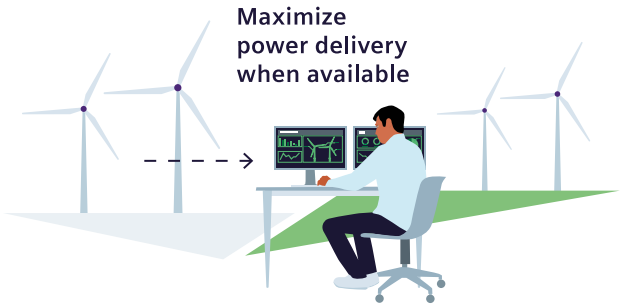
Infrastructure



Underutilized grid connection points: The nature of a wind farm results in an intermittent power supply to the grid, while the grid is usually designed for maximum power output. This difference often creates a deviation and leads to the grid connection being underused 70-80% of the time in many cases.

Operation mode

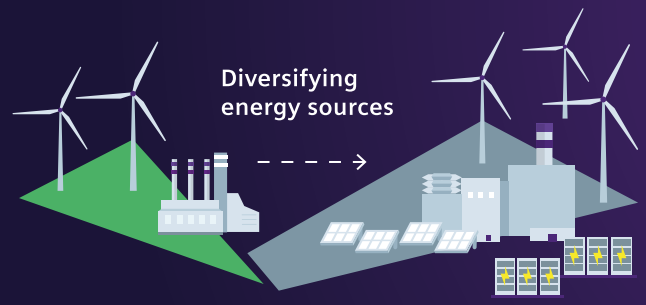
Controllers lacking additional grid services: Normally, a wind park includes a controller that is heavily tied to the wind turbine specifics. Its primary goal is to maximize power delivery to the grid when wind is available. However, current wind park controllers are not equipped to provide additional grid services.



Future situation

Infrastructure

Optimized grid infrastructure: Oversizing the intermittent energy production helps to meet the energy demand at the grid connection point. By diversifying energy sources and incorporating storage solutions, it's possible to shift energy delivery to times of higher demand or lower production, reducing dependency on any single energy source. Additional energy storage systems help to shift energy delivery and eliminate the weak points of the intermittent energy sources.



Operation mode



As renewable energy sources become increasingly important, they will need to contribute more and more energy and services to the grid. For this there are two possibilities:

1. **Limit energy transmission**: Keeping a reserve available that can be released when the grid requests additional power (primary / secondary frequency support)

2. **Battery Energy Storage Systems**: Including energy storage into existing grid connections enables optimized remuneration as well as delivering grid services.

Optimization of the infrastructure and integration of grid services are pushing both existing and newly built wind parks to think hybrid.

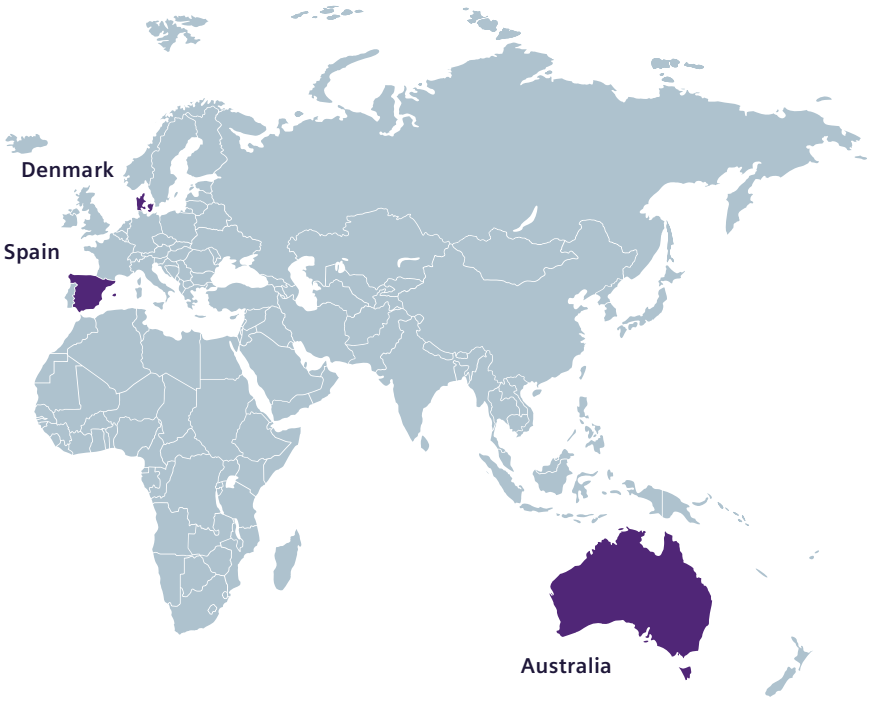
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2. Change in grid code and legislation

Various countries are aligning their grid regulations to accommodate and promote the hybridization of wind power, signaling a global shift towards more flexible and sustainable energy solutions. Examples of these changes can be seen in the efforts of entities such as Energinet in Denmark, and regulatory adjustments within Spain and Australia.

European grid codes now include provisions for utility-scale hybrid power plants, and countries are addressing the specific regulatory challenges posed by the hybridization of renewable energy generation installations.

More and more countries are aligning their grid regulations for hybrid plants



Denmark

Energinet, Denmark's transmission system operator, has established comprehensive grid codes that govern the integration of hybrid power plants combining wind, solar, and storage technologies. These codes specify requirements for frequency and voltage operation ranges, active power control, and reactive power management, ensuring that hybrid plants can support grid stability and reliability. While **the Danish grid code aligns with European Commission regulations**, it also allows for national specifications, highlighting the need for similar advancements in grid codes in other regions, such as India, to facilitate the smooth deployment of hybrid plants.

Spain

The hybridization of renewable energy generation installations in Spain, regulated by **Royal Decree-Law 23/2020**, allows for the integration of different energy sources or storage solutions at the same grid connection point, enhancing the efficiency of electricity generation. Since 2012, Spain has seen significant growth in renewable energy capacity, with photovoltaic power **increasing by 371% and wind power by 50% by the end of 2022**, while the regulation permits existing installations to incorporate new technologies without needing a new grid access permit, provided certain conditions are met.

Australia

The Australian Energy Market Operator (AEMO) has updated the registration **requirements for hybrid plants in the National Electricity Market (NEM)**. These plants enhance energy networks with high renewable and solar penetration by providing increased flexibility and resilience, making them an economically viable solution.

All hybrid systems must be registered with AEMO and classified according to their capacity and operational characteristics. **Compliance with the National Electricity Rules (NER) is mandatory**, with classification based on total system capacity.

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3. Why a reliable control system is needed

Maintaining grid compliance and ensuring electrical stability in hybrid plants can be challenging. Operators must coordinate the management of multiple assets. Both the attraction and the technical challenge of hybrid plants stems from variability of energy sources like wind and solar.

Operators must make decisions about when to store or dispatch power based on predictions about power production, demand, price, and other factors – and based on the real outputs of the assets.

Done well, hybrid plants enable optimization and can even open new revenue streams like participation in ancillary markets. Ancillary markets require power producers to meet strict performance requirements to qualify for participation – requirements that wind power can better meet as a part of a hybrid plant.

A one-stop shop for hybrid plants

Siemens Energy and Siemens Gamesa are your trusted partners for hybrid projects. As a one-stop shop for hybrid plants, we provide comprehensive solutions that address key challenges, including optimizing energy production and storage while enhancing cybersecurity. Together, we safeguard critical infrastructure against potential threats and ensure seamless coordination between various equipment types.

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4. Why Omnivise is the best choice for your next project

The Omnivise solutions support every stage of planning, development, and operation for a hybrid plant. Experts from Siemens Energy and Siemens Gamesa collaborate with clients to identify which solutions best fit their projects. This collaboration results in a unified approach throughout the project lifecycle that ensures compliance with TSO requirements and offers tools to enhance financial returns on investment.

The unique requirements of a specific site or facility can be addressed through tailored solutions covered in the Omnivise suite. These solutions are capable of integrating, managing, and optimizing a diverse array of energy assets, providing clients with the flexibility to choose their desired asset combination for a hybrid plant. Based on client requirements, Omnivise solutions can assist in stabilizing microgrids, maximizing financial returns, reducing emissions, or balancing various performance metrics.

Our skilled engineers possess a deep understanding of grid requirements and power generation assets. The teams at Siemens Energy and Siemens Gamesa leverage a vast knowledge base to model assets, design control systems tailored to specific sites, plan for compliant grid connections, and implement operations that are adaptable and easy to maintain. Consequently, clients utilizing the Omnivise solutions are equipped with the necessary capabilities to make well-informed decisions throughout the project lifecycle.

Learn more about Omnivise Hybrid Control

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4.1 Omnivise ecosystem with an integrated control approach

Addressing and optimal planning

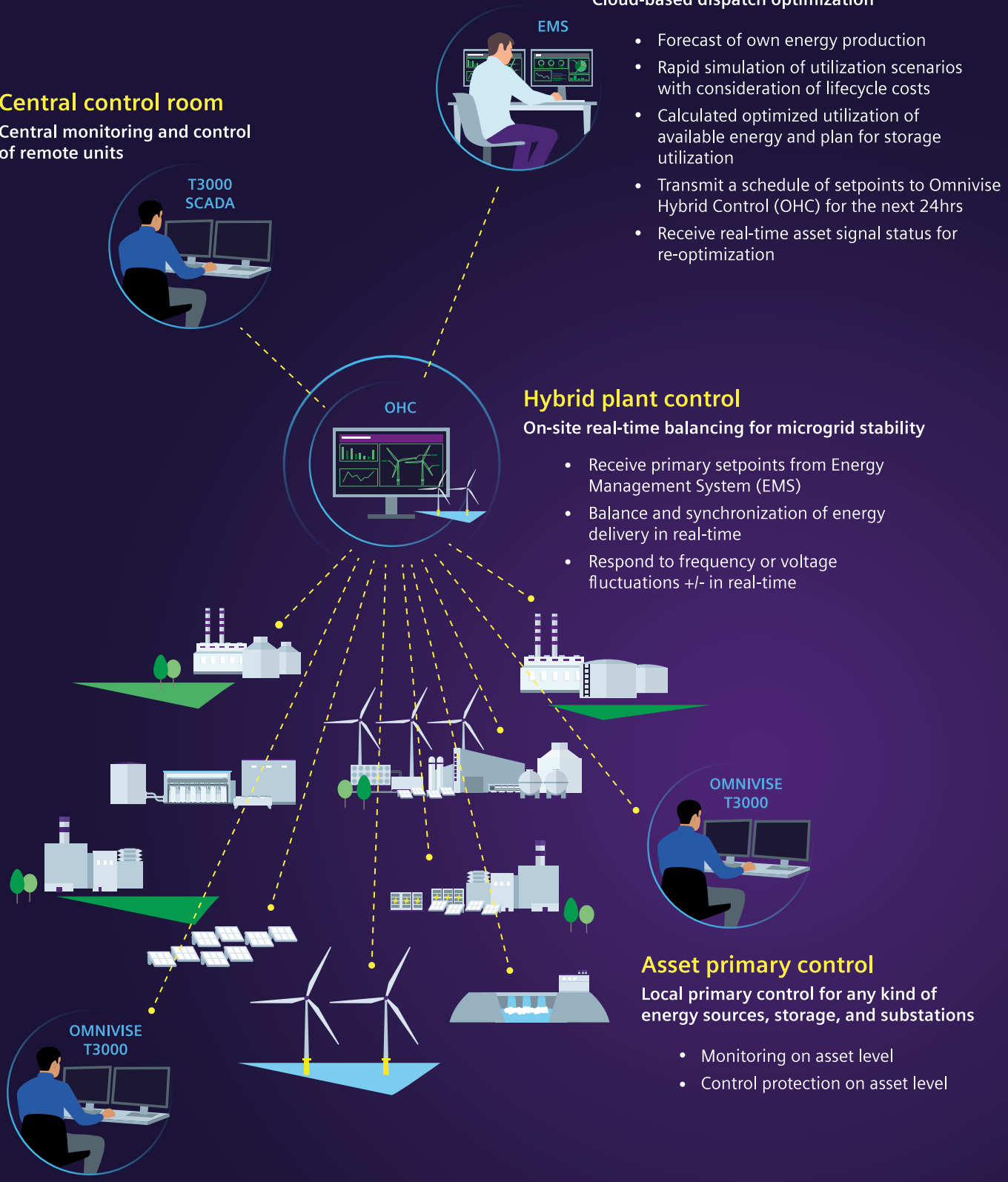
Energy management

Cloud-based dispatch optimization

- Forecast of own energy production
- Rapid simulation of utilization scenarios with consideration of lifecycle costs
- Calculated optimized utilization of available energy and plan for storage utilization
- Transmit a schedule of setpoints to Omnivise Hybrid Control (OHC) for the next 24hrs
- Receive real-time asset signal status for re-optimization

Central control room

Central monitoring and control of remote units



Hybrid plant control

On-site real-time balancing for microgrid stability

- Receive primary setpoints from Energy Management System (EMS)
- Balance and synchronization of energy delivery in real-time
- Respond to frequency or voltage fluctuations +/- in real-time

Asset primary control

Local primary control for any kind of energy sources, storage, and substations

- Monitoring on asset level
- Control protection on asset level

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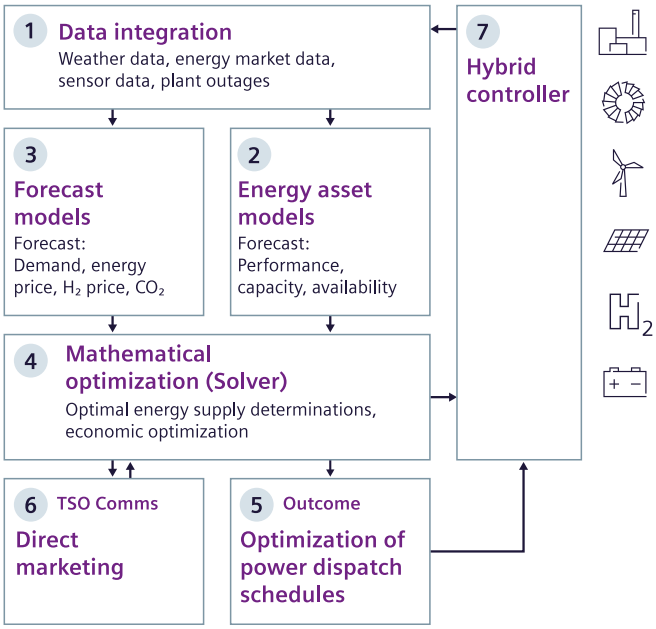
4.2 Omnivise Energy Management

Omnivise Energy Management Solution (EMS) serves as a dynamic co-ordinator of energy assets. It can forecast energy production and predict achievable price points for potential energy off-takers (such as electricity, ancillary service markets, and hydrogen customers). Using these predictions and its real-time data collection, Omnivise EMS can manage energy dispatch, monitor operational limits, and optimize or maximize the remuneration scheme.

Working in coordination with Omnivise Hybrid Controller, this comprehensive energy management approach ensures the seamless integration and coordination of diverse energy resources, ultimately maximizing efficiency and reliability within the hybrid plant environment.

Forecasting energy production and price points

Omnivise Energy Management Solution forecasts energy production by leveraging advanced analytics to accurately predict output from wind and other renewable energy sources.



Omnivise Energy Management working principle

The solution assesses the potential price points achievable for various energy off-takers, including electricity markets, ancillary service markets, and emerging hydrogen customers. This proactive approach enables informed decision-making and optimized energy dispatch, aligning the hybrid plant's production capabilities with market opportunities.

4.3 Omnivise Hybrid Controller

Omnivise Hybrid Controller facilitates the integration and synchronization of various energy assets, such as wind turbines, energy storage systems, hydrogen electrolysis, solar PV, or synchronous condensers.



Omnivise Hybrid Controller deep-dive

By using Omnivise Hybrid Controller, operators can manage combinations of these resources to achieve a harmonized and balanced energy output that contributes to the stability and reliability of the electrical grid.

Omnivise Hybrid Controller enables operators to guarantee grid code compliance within an wind hybrid plant. By ensuring the seamless integration and coordinated control of diverse energy resources, the controller facilitates adherence to grid code requirements and standards.

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The advanced functionalities of Omnivise Hybrid Controller enable operators to implement grid code-compliant operation strategies, including active power control, reactive power management, power factor control, and fault ride-through capabilities. These capabilities are essential for ensuring that wind assets operate in accordance with grid codes, standards, and regulations, thereby contributing to grid stability and system resilience.

Omnivise Hybrid Controller's ability to facilitate seamless communication with onshore grid infrastructure, coupled with its intelligent decision-making based on real-time data, supports the implementation of grid code-compliant control actions. This ensures that the hybrid plant actively contributes to grid support functions, such as frequency regulation and voltage control, in alignment with regulatory requirements.

A hybrid plant enhances several important requirements, including:

- Improving inertia response
- Fulfilling primary frequency control
- Avoiding the use of wind turbines as spinning reserves, which helps prevent energy waste
- Complying with demanding active power ramps at the Point of Interconnection (POI)

These improvements contribute to a more efficient and reliable energy system.

4.4 How Omnivise Hybrid Control optimizes plant operation

Grid compliance: Ensuring hybrid plant synergy



OHC ensures coordination among different assets

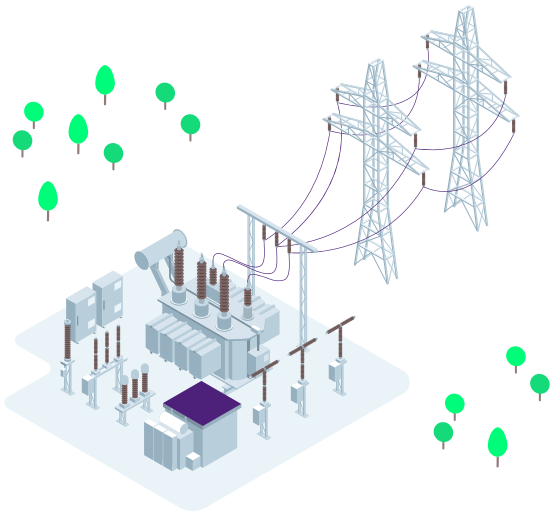
When combining multiple types of equipment at a single grid connection point, it is crucial to ensure that the hybrid plant remains compliant with grid standards.

An integrated control solution is key to ensuring reliable operation and grid compliance. Siemens Energy's Omnivise Hybrid Controller ensures coordination among various primary equipment to **maintain grid compliance**.

Omnivise Hybrid Control manages set points across generation and storage assets. This coordination is the basis for strategies that optimize for financial performance, energy efficiency, asset lifetime or many other metrics. Importantly, Omnivise Hybrid Control can maintain communication with the grid while adding new assets or upgrades to existing assets, making it compatible with further growth.

Ancillary services: Adding value with precision

Ancillary services are becoming a critical aspect of wind park operations, and the Omnivise Hybrid Controller includes functionality to support these services. Accurate **production forecasting** is essential to provide grid support



OHC supports ancillary services and meets energy market commitments

and fulfill energy market commitments. This may involve retaining energy within the wind park or storage systems to be dispatched as needed for services like frequency support. Including energy storage systems can also help the reactive power market by delivering extra capacity.

Additionally, the wind farm and wind turbine generators (WTG) possess functionalities for ancillary services, which can be activated and coordinated by the Omnivise Hybrid Control in the integrated management of the wind farm and WTG controllers.

Cybersecurity: Protecting critical infrastructure

Given their size and role in grid support, wind and hybrid installations are increasingly recognized as **critical infrastructure**. This recognition underscores the importance of cybersecurity. While individual components such as park controllers (MySite360) and battery storage controllers may be secure in isolation, the collective cybersecurity of a hybrid system requires a holistic approach.



Our secure-by-design approach ensures that your hybrid plant is safe and resilient against cyber threats

Siemens Energy's Omnivise T3000 takes a top-down methodology to ensure the cyber resilience of the entire hybrid plant, encompassing all interconnected devices and systems to prevent breaches and ensure reliable operation.

Omnivise T3000 is certified according to IEC 62443, supports network segregation, and meets the highest cybersecurity standards by deeply integrating security into the entire design process, a concept we call "**secure-by-design**." This approach allows T3000 operators to comply with cybersecurity regulations both now and in the future.

Optimal commercialization: Intelligent energy management

The Omnivise Hybrid Controller, when integrated with Omnivise Energy Management, **provides an intelligent platform** for energy market participation. This system



OHC and EMS work together seamlessly to give you peace of mind

offers advanced production and price forecasting across various energy markets, e.g. day-ahead and intra-day markets, enabling plant owners to optimize the timing and revenue of energy sales. This includes strategies for balancing energy supply and demand and leveraging storage assets to shift energy delivery to the most advantageous times.

Using the Omnivise Energy Management System allows the hybrid plant owners to maximize revenues by selling energy when the electricity prices are high and storing energy when prices are low.

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5. Combined power: strong domain know-how and cutting-edge components from Siemens Gamesa and Siemens Energy

Proven track record

Siemens Gamesa and Siemens Energy have established a history of successful hybrid power plant implementations. Ever since the two companies merged under the Siemens Energy umbrella, the partnership has remained strong and has continued to grow.

Multiple notable examples including projects in Denmark and the UK, where hybrid solutions have demonstrated their efficiency and reliability.

Project de-risking

Hybrid projects benefit from a streamlined supply chain and coordinated project management, offering investors reduced risk, improved bankability, and enhanced confidence. Siemens Energy's and Siemens Gamesa's unified approach to project execution simplifies the process from planning, project development, EPC integration, installation, and commissioning as well as after-sales service. This coordination extends to technical support, where a single source for equipment ensures comprehensive system understanding and efficient problem resolution.

Simplified operation and maintenance

Operating and maintaining a hybrid system is simplified when all components originate from one single OEM. Stakeholders benefit from a unified system architecture and interface, reducing training complexity and costs. Siemens Energy's commitment to innovation ensures that EMS solutions remain at the forefront of technology, adaptable to future advancements. Moreover, the EMS service model ensures ongoing model accuracy, incorporating updates and improvements that reflect the latest technological advances.

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Optimized compatibility and performance

Siemens Energy's Energy Management System (EMS) offers a tailored solution to enhance the functioning of wind power facilities. Using advanced computer models that reflect the details and design of wind turbines, the EMS can effectively simulate and improve the performance of wind energy systems. This advanced modeling grants the EMS the foresight to anticipate operational shifts, empowering it to make smarter, more informed decisions that benefit wind power production.



The EMS benefits from Siemens Energy's extensive knowledge of wind turbine performance trends and wear-and-tear patterns, utilizing this information to proactively maintain and extend the operational life of wind power equipment. By preempting maintenance needs, the EMS helps ensure that wind turbines run more smoothly and efficiently, thereby boosting the overall output and dependability of wind power generation.

Leveraging the vast experience Siemens Energy has gained from wind energy projects around the world, the EMS incorporates a wealth of best practices and operational insights. This enables the EMS to navigate challenges proficiently and seize opportunities effectively, which is crucial for strategic risk management and planning in the wind power sector.

The EMS is engineered to integrate seamlessly with Siemens Gamesa's wind turbine equipment, fostering a cohesive and interoperable environment within the power plant. This streamlined integration ensures that data from different parts of the wind power operation are synthesized accurately, achieving a reliable communication between the Omnivise Hybrid Controller and the Siemens Gamesa wind turbines to optimize the response and enhancing the monitoring and control capabilities of the system. Ultimately, the EMS stands as a prime example of how integrated, well-matched components can significantly elevate the efficiency and reliability of wind power operations.

Hybrid control for data centers

Data centers are becoming increasingly important. The high energy demand requires new concepts to allow data centers to meet their energy needs while contributing to a greener future. The hybridization of energy systems, particularly through the integration of wind turbines, presents a transformative opportunity for industrial customers, including data centers, to enhance their energy independence and sustainability. By installing wind turbines, these facilities can generate renewable energy for on-site consumption, significantly reducing reliance on the grid and minimizing energy costs.

The Omnivise Hybrid Controller (OHC) plays a crucial role in this process by managing the data center's energy production to prevent surplus generation, ensuring that excess energy is not exported back to the grid. While the OHC effectively handles production management, it is often complemented by a Battery Energy Storage System (BESS) to fully optimize energy usage and storage capabilities.

For clients looking to maximize their renewable energy potential, the addition of photovoltaic (PV) systems alongside wind turbines and BESS creates a comprehensive OHC solution. This integrated approach not only enhances energy efficiency but also supports the transition to a more sustainable operational model.

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6. Conclusion

The evolving landscape of grid code compliance and regulatory requirements presents challenges for hybrid wind power plants, with many markets facing unclear and changing regulations. The technical risks and complexities associated with these systems are significant, and the growing control requirements add to the challenges.

In this context, the strategic integration of Siemens Energy's Hybrid Controller with the EMS and Siemens Gamesa's park controller (MySite360) offers a robust solution for hybrid wind power plants. This combination not only enhances grid compliance and participation in ancillary services but also ensures cybersecurity and optimal commercialization of energy resources. **By adopting this integrated approach, plant owners and operators can expect a high-performance, secure, and economically viable hybrid energy system that stands the test of time.**

Siemens Energy and Siemens Gamesa emerge as trusted partners, providing a comprehensive one-stop shop to help mitigate risks and reduce capital expenditures (CapEx). We offer support throughout the entire lifecycle of your hybrid project, ensuring its success from development to operation.

As we navigate these exciting times, our collaboration can help you address the complexities of hybrid plants, allowing you to focus on achieving your energy goals while we manage the associated risks. With Siemens Energy and Siemens Gamesa by your side, you can confidently embrace the future of hybrid renewable energy.

The future of energy lies in the seamless integration of hybrid systems, where innovation meets sustainability to create a resilient and future-proof power landscape.



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