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AquaEnergy Expo Magazine

The Voice of Water and Energy World

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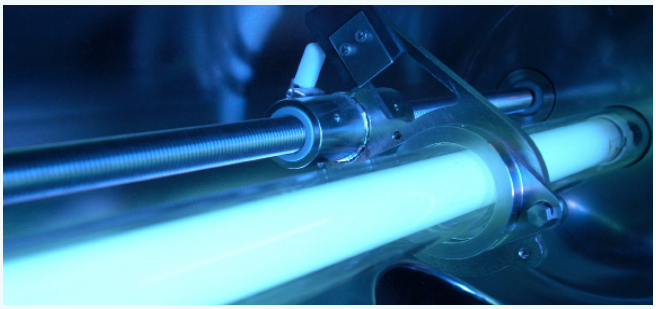

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Editor Word

Welcome to the March issue of AquaEnergy Expo magazine...

Digital sustainability has the potential to radically transform the world and represents a 21st century tool to combat climate change and promote sustainability. Siemens plays a major role in moving towards sustainability. Among the efforts made to contribute to achieving sustainability and a carbon-free climate, we talked about the research of water treatment specialist Dr. Muhammad Askar, in which he discussed the possibility of reducing the carbon footprint in water treatment plants in Saudi Arabia.

Moving from combating climate change to solving the problem of water scarcity and pollution, in our special issue we looked at that problem and China's efforts to address it through advanced wastewater treatment such as MBR. And also, Jordan's efforts to confront this crisis by producing 300 million cubic meters of desalinated drinking water annually, with international support through the Aqaba-Amman Water Desalination and Conveyance Project.

In order to conserve water, we delve into the escalating issue of water usage in data centers, and explores the crucial strategies for enhancing water usage efficiency in this critical sector. More importantly, generating energy requires water for the cooling systems. So, we talked about the impact of cooling systems on water usage.

In the latest issue of AquaEnergy expo magazine, readers will be witnesses to this new reality and will know more about the revolution in water and wastewater industry by understanding the role of drones in developing water and wastewater industry.

Additionally, we talked about the best example of a net-carbon climate is the country of Iceland, where Iceland has natural sources of power such as volatile volcanoes loom over frozen glaciers giving the country its deserved reputation as "The land of fire and ice", and Iceland has made the best use of its renewable energies.

And of course, we will not forget to talk about the city of NEOM, its technological progress, and its ambitious plans to build a mountain resort called Trojena.

In order to achieve a zero-carbon climate, scientists are conducting research to discover ways to produce green hydrogen at lower costs, so they produced hydrogen directly from seawater opening up the possibility of an abundant and sustainable source of green hydrogen.

As the country transitions away from coal and embraces wind and solar power, the need for efficient and reliable energy storage becomes increasingly clear. Australia has made pumped hydro storage as a vital component of renewable energy storage.

Finally, thank you for being a part of our magazine community. We are grateful for your readership and look forward to bringing you more exciting content in the future.

Warm Regards,

Mohamed Khalifa

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MOHAMED ASKAR

Water Treatment Specialist
Riyadh , Saudi Arabia

“ Reduce Carbon Footprint in Water Treatment Plants in Saudi Arabia ”

Water treatment plants play a crucial role in providing clean and safe water to meet the growing demand in Saudi Arabia

Saudi Arabia faces the challenge of meeting the increasing demand for water resources while simultaneously addressing environmental concerns, such as reducing greenhouse gas emissions. Water treatment plants are energy intensive facilities, consuming significant amounts of electricity and contributing to the carbon footprint. Assessing strategies to reduce the carbon footprint in water treatment plants is essential for sustainable water supply management. This study aims to evaluate different approaches and technologies to minimize carbon emissions while ensuring efficient water treatment processes. Water scarcity is a pressing issue in Saudi Arabia due to its arid climate and rapid population growth. To address this challenge, water treatment plants have been established throughout the country, ensuring a reliable supply of potable water. However, the energy consumption associated with water treatment processes leads to substantial carbon emissions. This research aims to explore strategies that can effectively reduce the carbon footprint of water treatment plants in Saudi Arabia, thereby promoting sustainable water management practices.

1. Methodology

This research utilizes a combination of literature review, case studies, and techno-economic analysis to assess strategies for reducing the carbon footprint in water treatment plants in Saudi Arabia. The literature review provides an overview of existing research and best practices in carbon footprint reduction in water treatment plants worldwide. Case studies analyze specific water treatment plants in Saudi Arabia, evaluating the effectiveness of implemented strategies. Techno-economic analysis assesses the feasibility and cost-effectiveness of different strategies in reducing carbon emissions.

1.1 Data Collection

Data collected from existing water treatment plants across Saudi Arabia, including their energy consumption patterns, water treatment processes, and carbon emissions. This data will provide baseline information to assess the current carbon footprint of these facilities

1.2 Energy Efficiency Assessment

Energy-efficient technologies and practices play a crucial role in reducing the carbon footprint of water treatment plants. In this study, various energy-saving technologies and practices will be evaluated to identify their potential for energy savings and carbon emission reductions. One of the key areas of focus will be advanced filtration systems. These systems utilize innovative filtration technologies . By evaluating the energy consumption of these systems and comparing them to traditional filtration methods, the potential energy savings can be determined. Additionally, the associated carbon emission reductions can be estimated, highlighting the environmental benefits of implementing advanced filtration systems. Optimized pumping systems will also be assessed as part of the energy efficiency evaluation. Pumping systems are critical components

in water treatment plants, and their energy consumption can be significant. By analyzing the efficiency of existing pumps and exploring energy-efficient alternatives, potential energy savings can be identified. This evaluation will involve assessing pump designs, motor efficiency, control systems, and operational practices to optimize energy consumption. Simulations and energy audits will be conducted to estimate the energy consumption reduction potential and the resulting carbon emission reductions associated with these optimized pumping systems.Energy recovery devices will be another focus area in this study. These devices capture and utilize energy that would otherwise be wasted, such as the energy from pressure release valves or wastewater streams. By implementing energy recovery devices, water treatment plants can significantly reduce their energy consumption and carbon emissions.

The potential energy savings and carbon emission reductions associated with these devices will be assessed through energy audits and simulations. To estimate the overall energy consumption reduction potential and associated carbon emission reductions, energy audits and simulations will be conducted. Energy audits involve a detailed analysis of energy consumption patterns in water treatment plants, identifying areas of high energy consumption and potential for improvement. Simulations will provide a virtual platform to assess the impact of implementing various energy-efficient technologies and practices on energy consumption and carbon emissions. These assessments will provide quantitative data on the potential energy savings and carbon emission reductions achievable through the adoption of energy-efficient technologies and practices.

1.3 Renewable Energy Integration

The feasibility of integrating renewable energy sources, particularly solar and wind power, into water treatment plants will be a crucial aspect of this study. The aim is to assess the viability and advantages of utilizing these renewable energy sources to reduce the carbon footprint of water treatment plants. Techno-economic analyses will be conducted to determine the optimal configuration and capacity of renewable energy systems, taking into account the specific geographical and climatic conditions of different regions in Saudi Arabia. In evaluating the feasibility of integrating solar power into water treatment plants, factors such as solar irradiation levels, available land area, and regulatory frameworks will be considered.

The study will assess the potential for installing solar photovoltaic (PV) panels on the rooftops of water treatment plant buildings or utilizing open land areas adjacent to the plants for larger-scale solar PV installations.

Techno-economic analyses will be performed to determine the optimal capacity of solar PV systems, considering factors such as energy demand, available space, and the financial viability of the projects. Additionally, the study will assess the potential for incorporating solar thermal systems for water heating purposes, further enhancing the energy efficiency of the plants. The assessment of wind power integration will involve evaluating wind resources in different regions of Saudi Arabia. Wind mapping data will be analyzed to identify areas with favorable wind conditions for harnessing wind energy. The study will explore the potential for installing wind turbines near water treatment plants or in nearby wind farms. Techno-economic analyses will be conducted to determine the optimal turbine capacity, considering wind speed, turbine efficiency, and the energy demand of the water treatment plants.

> *"The geographical and climatic conditions of different regions in Saudi Arabia will play a significant role in determining the optimal configuration and capacity of renewable energy systems."*

Factors such as solar irradiation levels, wind speed, and temperature variations will be considered to ensure the compatibility between the renewable energy sources and the water treatment plants' energy demands. The financial viability and payback periods of the renewable energy systems will also be assessed, taking into account factors such as government incentives, electricity tariff structures, and the costs of equipment, installation, and maintenance. The findings of the techno-economic analyses will provide valuable insights into the optimal integration of renewable energy sources into water treatment plants in Saudi Arabia. These insights will assist in making informed decisions regarding the configuration, capacity, and financial feasibility of the renewable energy systems. By incorporating solar and wind power into water treatment plants, it will be possible to reduce the reliance on conventional energy sources, decrease carbon emissions, and enhance the sustainability

1. 4 Process Optimization

Process optimization techniques play a crucial role in enhancing the efficiency of water treatment plants. This study aims to investigate the utilization of advanced control systems, data analytics, and predictive maintenance to optimize processes and improve energy efficiency. By implementing these techniques, energy consumption can be optimized, wastage can be reduced, and carbon emissions can be minimized. Advanced control systems provide a means to optimize the operation of water treatment processes. These systems employ real-time monitoring and feedback mechanisms to adjust process parameters, ensuring optimal performance and energy efficiency.

> *By continuously analyzing data from sensors and instruments, these control systems can make informed decisions regarding process adjustments, minimizing energy consumption while maintaining water quality and treatment efficacy.*

Data analytics techniques will be explored to uncover valuable insights from the vast amount of data generated by water treatment plants. By applying data mining, machine learning, and statistical analysis techniques, patterns and correlations within the data can be identified. These insights can be used to optimize process parameters, identify energy-intensive areas, and develop predictive models for optimizing energy consumption. Additionally, data analytics can help identify anomalies and optimize maintenance schedules, preventing equipment failures and reducing energy wastage.

> *Predictive maintenance techniques will also be investigated to enhance the reliability and efficiency of water treatment plants*

By employing condition monitoring, sensor data analysis, and machine learning algorithms, potential equipment failures can be predicted, allowing for proactive maintenance. This approach minimizes unscheduled downtime, reduces energy wastage associated with faulty equipment, and improves overall plant efficiency. The combination of advanced control systems, data analytics, and predictive maintenance techniques water treatment plants. By leveraging real-time data, optimizing in process parameters, and proactively maintaining equipment, energy consumption can be minimized, wastage can be reduced, and carbon emissions can be mitigated. The implementation of these process optimization techniques will require the integration of sensors, data acquisition systems, and advanced control algorithms into the existing infrastructure of water treatment plants. Furthermore, data management and cybersecurity measures will be implemented to ensure the secure and efficient handling of the generated data.

2. Results

The literature review conducted in this study has provided valuable insights into various strategies for reducing the carbon footprint of water treatment plants. Several approaches have been identified, including the use of energy-efficient technologies, integration of renewable energy sources, process optimization techniques, and the implementation of carbon capture and storage methods. Additionally, case studies from specific water treatment plants in Saudi Arabia have demonstrated the successful implementation of these strategies, resulting in significant carbon emissions reductions. Techno-economic analysis has also been employed to assess the feasibility and cost-effectiveness of these strategies, shedding light on their potential benefits and challenges.

> *Energy-efficient technologies have emerged as a crucial strategy for reducing the carbon footprint of water treatment plants*

These technologies encompass a range of innovations, such as advanced filtration systems, optimized pumping systems, and energy recovery devices. Studies have shown that the implementation of energy-efficient technologies can lead to substantial energy savings and subsequent reductions in carbon emissions. Furthermore, these technologies often result in long-term cost savings, making them economically viable options for water treatment plants. The integration of renewable energy sources, such as solar and wind power, has also been identified as an effective strategy for reducing the carbon footprint of water treatment plants. By harnessing the abundant solar irradiation and wind resources available in Saudi Arabia, water treatment plants can generate clean energy to meet their electricity demands. Case studies have highlighted successful examples of solar PV installations and wind turbine

integration, showcasing the potential for significant carbon emissions reductions. Techno-economic analysis has provided insights into the feasibility and cost-effectiveness of these renewable energy integration strategies, considering factors such as resource availability, infrastructure requirements, and financial viability. Process optimization techniques have also been recognized as effective means of reducing the carbon footprint of water treatment plants. These techniques encompass the use of advanced control systems, data analytics, and predictive maintenance approaches.

By optimizing process parameters, minimizing energy consumption, and proactively maintaining equipment, water treatment plants can significantly reduce their carbon emissions. Case studies have demonstrated the successful implementation of process optimization techniques, resulting in improved efficiency and reduced environmental impact. Carbon capture and storage (CCS) methods have also been explored as a potential strategy for reducing the carbon footprint of water treatment plants. CCS involves capturing carbon dioxide emissions from the plants exhaust gases and storing them underground, preventing their release into the atmosphere. While still in the early stages of development and implementation in water treatment plants, CCS has shown promise in reducing carbon emissions. Techno-economic analysis has provided insights into the feasibility and cost-effectiveness of CCS, considering factors such as capture technologies, storage options, and associated infrastructure requirements.

2.1 Discussion

The results indicate that a combination of strategies is necessary to achieve substantial carbon footprint reductions in water treatment plants in Saudi Arabia. Energy-efficient technologies, such as high-efficiency pumps and motors, membrane technologies, and advanced process control systems, can significantly reduce energy consumption and car-bon emissions. The results indicate that a combination of strategies is necessary to achieve substantial carbon footprint reductions in water treatment plants in Saudi Arabia.

Energy-efficient technologies, such as high-efficiency pumps and motors, membrane technologies, and advanced process control systems, can significantly reduce energy consumption and carbon emissions. Integration of renewable energy sources, such as solar and wind, can further reduce reliance on fossil fuels. Process optimization, including improved plant design, operation, and maintenance practices, can enhance energy efficiency and minimize carbon emissions. Carbon capture and storage technologies offer a potential solution for capturing and storing CO2 emissions generated during the water treatment process.

Conclusion

This study underscores the importance of reducing the carbon footprint in water treatment plants in Saudi Arabia through a holistic approach. Strategies include adopting energy-efficient technologies, integrating renewable energy sources like solar and wind power, optimizing processes, and implementing carbon capture and storage (CCS). Energy-efficient technologies such as advanced filtration systems and optimized pumping systems can reduce energy consumption and emissions, leading to cost savings. Renewable energy integration can harness clean energy from abundant solar and wind resources. Process optimization techniques like advanced control systems and predictive maintenance help minimize energy consumption and waste. CCS involves capturing CO2 emissions for storage underground. Further research is recommended to evaluate the long-term performance and scalability of these strategies in different plant settings. Implementing these strategies can significantly reduce carbon emissions, enhance sustainability, and improve the efficiency of water supply systems in Saudi Arabia.

Trends and Challenges of China's Membrane Bioreactor Market

China, with its massive population, faces water scarcity and pollution due to rapid industrialization, impacting drinking water safety and river health. To combat this, advanced wastewater treatment like MBR technology is crucial for cleaning and reusing water, preserving resources. MBR's compact size allows for on-site application in densely populated areas without major infrastructure disruptions, offering a sustainable solution to China's water challenges.

1. The Growth of MBR in China's Water Treatment Sector

The Chinese Membrane Bioreactor market is set to grow from 2024 to 2028 due to the rising demand for water treatment solutions driven by dwindling freshwater resources. The residential sector seeks chemical-free, pure drinking water, leading to increased MBR use in various buildings. Environmental concerns about sanitation and wastewater disposal are also fueling market growth. China aims to boost water reuse rates by over 25% by 2025, promoting wastewater reuse for household, industrial, ecological, and agricultural purposes. Over 80% of China's municipal water reuse volume (12.62 billion m3 in 2019) is used for commercial and industrial purposes like cooling water and processing. Urban applications include toilet flushing, gardening, and car washing. The low urban water reuse rate (19.9%) and high wastewater treatment rate (96.3%) in 2019 indicate a growing demand for membrane bioreactors in the future.

2. Key Players in China's Membrane Bioreactor Market

In recent years, China's average annual growth rate has been close to 100%, compared to the global MBR market's average annual growth rate of 10.9%.Leading players such as Supratec focus on microfiltration/ultrafiltration membranes and microporous aeration to enhance water quality and meet strict discharge standards. Beijing Origin Water and CITIC Envirotech are prominent in China's MBR market, supplying a significant portion of the country's MBR capacity. Foreign manufacturer Veolia Water Technologies holds a 10% market share, emphasizing the integration of ZeeWeed membrane technology. Other established international MBR suppliers in China include DuPont, Mitsubishi Rayon, Kubota, Asahi Kasei, and Toray, contributing to the diverse MBR market landscape in China.

3. International Players in China's MBR Market

The current market for international players in membrane bioreactor (MBR) systems has become more challenging compared to the early 2000s when foreign brands dominated. Tsinghua University's analysis shows a decrease in foreign MBR players' market share from 61% in 2010 to 13% for municipal, and down from 75% in 2010 to 24% for large industrial MBRs (with capacities over 5,000m3/d).

3.1 Veolia Water Technologies

To stand out from local competition, international membrane specialists like Veolia are focusing on delivering cost-effective solutions and services that address historical issues with MBR systems, such as declining flux and high operating costs. Veolia integrates expert systems and digital services for operational efficiency, standardizes data monitoring, and offers cloud-based analysis. They diversify with innovative products like hybrid solutions incorporating membrane-compatible powdered activated carbon for COD removal.

An alternative MABR product enhances nutrient removal efficiency. It can integrate with existing processes like MBR into IFAS, providing customers with comprehensive process options and solutions to meet stringent discharge standards and remove micropollutants effectively.

4. Underground Sewage Treatment Plants

With rapid urbanization, great strains are not only being placed on the production of clean water; there is also an equal, if not, more important need to treat the increasing quantities of wastewaters being produced. With urbanization driving up land prices drastically, it makes good sense to leverage on technologies with smaller plant footprints, like the membrane bioreactor (MBR), as well as to adopt an innovative underground installation of the sewage treatment plant (STP), allowing a non-obnoxious co-existence with nearby residences. The total capacity of fully buried MBR plants in China has climbed to over 5 million m3/d as it becomes a nationwide fashion.

4.1 The Jingxi Underground STP

Being one of the largest underground STPs, the Jingxi Underground STP in Guangzhou is a 100,000 m3/day MBR-based treatment plant that was commissioned in 2010. With an underground depth of 20 metres, the Jing Xi MBR plant takes up the smallest ground area among all wastewater treatment plants in China, approximately 1/10 of a traditional water and wastewater treatment plant.

4.2 Beijing Huaifang: Asia's Largest Underground MBR-Based WWTP

In 2015, SUEZ collaborated with Beijing Drainage Group to upgrade the plant to become the largest underground MBR-based WWTP in Asia with advanced technology. The 3-floor plant in southwest Beijing spans 162,000 m2 and aims to enhance wastewater treatment capacity, flood control, and water quality. The plant can recycle 200 million m3 of wastewater annually, easing pressure on wastewater treatment in southern Beijing. Reclaimed water is used for industrial/commercial purposes and to replenish adjacent water bodies and wetland parks, offering environmental and economic benefits. The highly automated plant operates smoothly with less than 20 staff, contributing to sustainable development.

5. Rapid Growth of MBR Technologies in Industrial Applications in China

The industrial use of MBR technologies is rapidly increasing, especially in centralized industrial park WWTP upgrades for treating high-strength wastewaters from industries like chemicals, textiles, electronics, and food & beverage. In China, these projects are often implemented under the build-operate-transfer (BOT) model, favoring local membrane-based developers with strong financial backing. Origin Water, known for municipal MBR projects, is expanding into industrial park collaborations, offering technologies such as nanofiltration membranes and advanced oxidation solutions. They have successfully applied integrated MBR-AOP and MBR-NF solutions for industrial wastewater treatment, effectively removing various pollutants and ensuring high-quality treated water for reuse, thereby reducing the environmental impact of industrial operations. With a 30,000 m3/d capacity, Motimo Membrane Inc. constructed the largest MBR facility for the treatment of industrial wastewater in Tianjin, Petrochemical wastewater treatment is the main industrial use for MORS, and there are currently more than 10 MBR facilities with a combined capacity of more than 5000 m3/d.

6. Technological Innovations and Energy Efficiency in MBRs

MBRs require more energy than classical activated sludge (CAS) due to higher aeration needs for biological degradation and membrane scouring. Aeration consumes 70-80% of total energy in municipal wastewater treatment, with 40-60% used for the biology process. Lowering air usage can cut operating costs. Energy optimization is vital for broader MBR use in industry. Companies like CITIC Envirotech and Supratec are developing innovative solutions to reduce energy consumption. CITIC's double-deck membrane rack and large bubbles for pulse aeration cut air scouring rates by about 3L air/min/m2, saving 10-30% of aeration energy. Supratec's patented siphon aerator boosts air scouring efficiency, with a successful two-year global track record.

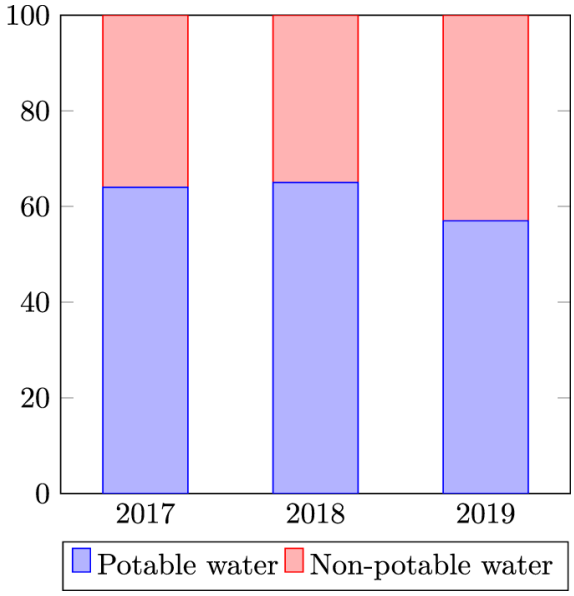
Water Usage Efficiency in Digital Data Centers

The rapid expansion of digital infrastructure in the modern era has led to a significant increase in data centers, which in turn has raised concerns about energy consumption and heat regulation. With water-based cooling being a primary method in data centers, the need to evaluate water usage effectiveness (WUE) becomes paramount. Despite the perception of water as abundant and cost-effective compared to electricity, the reality is that freshwater resources are limited and in high demand. This article delves into the escalating issue of water usage in data centers, and explores the crucial strategies for enhancing water usage efficiency in this critical sector.

1. Water Usage in Digital Data Centers

The world is rapidly shifting towards the digital realm in the new normal, leading to a proliferation of data centers to meet the increasing demands. However, this surge in data centers also escalates the need for more power, consequently requiring regulation of the generated heat. As data centers heavily rely on water-based cooling, it becomes essential to consider the water usage effectiveness (WUE). While water is often perceived as abundant and cost-effective compared to electricity, the reality is that freshwater resources are limited and in high demand. The United Nations' 2019 world water development report highlights the worsening issue of water scarcity, with global water usage increasing by approximately 1% annually since the 1980s and projected to rise by 20 to 30% by 2050. This surge in demand, coupled with an anticipated decrease in water supply due to climate change, is expected to lead to a shortfall in water supply of nearly 40% by 2030. Given that data centers consume a substantial amount of water, there is an urgent need to drastically reduce water usage for cooling.

2. Water Consumption and Data Centers in the USA



In 2015, the total water consumption in the USA amounted to 1218 billion liters per day, with thermoelectric power utilizing 503 billion liters, irrigation using 446 billion liters, and 147 billion liters being allocated daily to provide potable water to 87% of the US population. Data centers contribute to water consumption through two primary avenues: indirectly via electricity generation, traditionally through thermoelectric power, and directly through cooling processes. In 2014, US data centers were responsible for a total water usage of 626 billion liters. While this constitutes a small fraction in the context of the overall national figures, data centers still compete with other entities for access to local water resources. A medium-sized data center with a capacity of 15 megawatts (MW) consumes as much water as three average-sized hospitals or more than two 18-hole golf courses.

Although some progress has been achieved by utilizing recycled and non-potable water, limited data indicates that certain data center operators draw over half of their water from potable sources . This practice has sparked significant controversy in water-stressed areas, underscoring the importance of comprehending the water usage patterns of data centers.

3. Water Usage and Renewable Transition in Power Generation and Data Centers

Water usage in power generation is evaluated through withdrawal or consumption, where consumption typically involves water lost through evaporation, and withdrawal entails taking water from a source and later returning it. Power plants, fueled by fossil fuels or nuclear fission, utilize water to generate steam that drives turbines for electricity production. In the US, the average water intensity for electricity generation was 2.18 liters per kilowatt hour in 2015, with different fuel and generator technologies significantly impacting cooling water requirements. For instance, a dry air cooling system for a natural gas combined cycle generator consumes and withdraws minimal water, while a wet cooling system for a coal steam turbine uses and withdraws substantial amounts of water.

> *Consumption can range from 0.00 to 4.4 liters per kilowatt hour, and withdrawal can range from 0.31 to 533.7 liters per kilowatt hour, depending on system characteristics.*

Despite being considered a cleaner source of electricity, hydropower systems also require large volumes of water, with open reservoir water evaporation being a significant source of losses, particularly in dry regions. The US national average water consumption for hydropower is 16.8 L/kWh compared to 1.25 L/kWh for thermoelectricity. The transition to renewables is crucial for reducing both carbon and water intensity, as estimates suggest that by 2030, transitioning to wind and solar energy could significantly reduce water withdrawals in various countries. In the data center sector, major companies like Google and Microsoft are leading the shift to renewables, with the migration to cloud computing contributing to more efficient operations and lower power usage effectiveness (PUE) ratios. Between 2010 and 2018, the number of servers increased 6 times, network traffic increased 10 times, and storage capacity increased by 25 times, yet energy consumption has only grown by 6%, largely due to the efficient operations of cloud providers.

4. Data Center Cooling and Water Management

ICT equipment generates heat and requires temperature management. This process also occurs in data centers, where ICT equipment is located within a room or hall, and heat is ejected from the equipment via an exhaust and then cooled and recirculated. Data center rooms are designed to operate within temperature ranges of 20–22 °C, with a lower bound of 12 °C. As temperatures increase, equipment failure rates also increase. The general approach for data center cooling involves chillers reducing air temperature by cooling water—typically to 7–10 °C—which is then used as a heat transfer mechanism. Some data centers use cooling towers where external air travels across a wet media causing water evaporation. Other data centers use adiabatic economizers where water sprayed directly into the air flow cools the air entering the data center. A small 1 MW data center using traditional cooling can use around 25.5 million liters of water per year. Raising the chiller water temperature from the usual 7–10 °C to 18–20 °C can reduce expenses by 40% due to the reduced temperature difference between the water and the air. In cooler regions, less cooling is required, and free air cooling can be utilized, reducing capital expenditure by up to 30%. Google and Microsoft have built data centers without chillers, which is challenging in hot regions.

5. Key Methods and Strategies Enhancing Water Usage in Data Centers

It's crucial to assess and enhance WUE because it serves as an indicator of a facility's overall energy efficiency and sustainability. Several methods can promote more effective water usage:

5.1 Adjust temperature and humidity:

Increasing the temperature and humidity in a data center reduces the amount of heat that needs to be dissipated by the cooling tower's evaporative cooling process, leading to a reduction in chiller demand and excessive water use.

5.2 Utilize recycled water:

Recycling water drastically decreases the additional water supply needed, but it's important to consider the tradeoffs, as additional water treatment equipment may be required, potentially offsetting the gains in water usage efficiency.

5.3 Increase cycles of concentration:

Operating at higher cycles of concentration reduces cooling tower makeup water requirements and blow down, leading to significant water savings.

5.4 Leverage DCIM software:

Data Center Infrastructure Management (DCIM) software helps in measuring energy consumption, making more intelligent decisions, and improving efficiency metrics, ultimately leading to an improvement in WUE.

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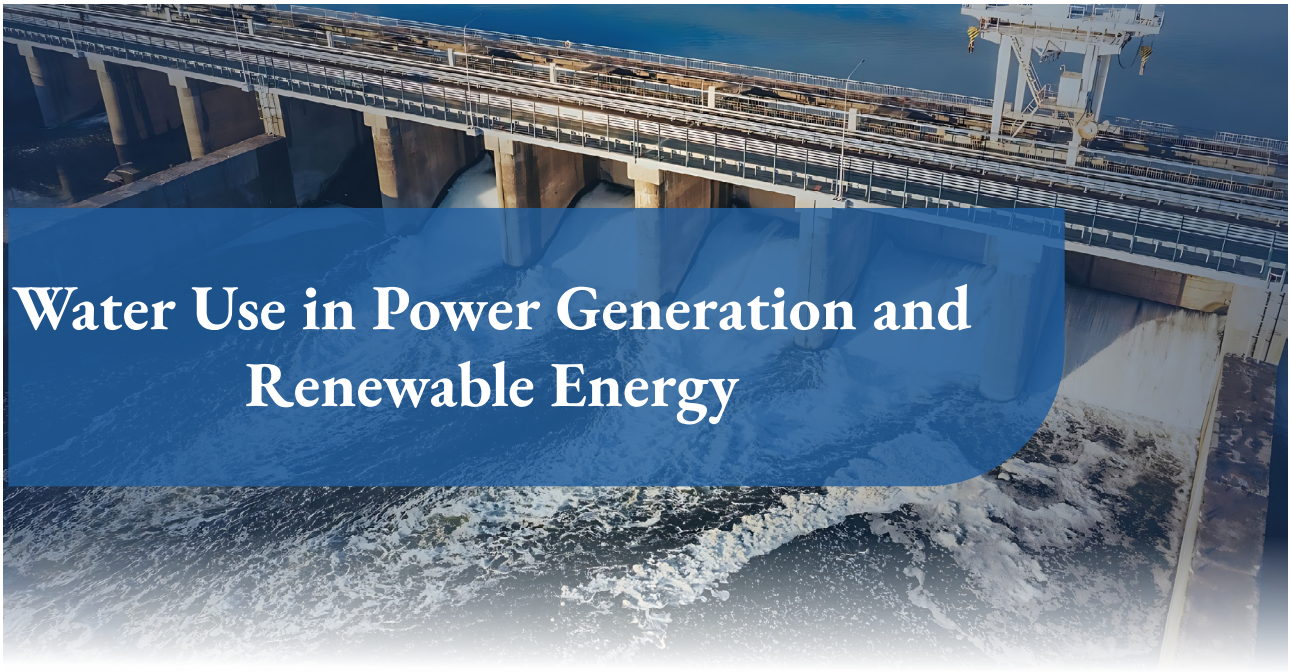

Water Use in Power Generation and Renewable Energy

Water is a vital resource in power generation, with its usage in power plants involving both withdrawal and consumption. This article delves into the significant impact of cooling systems on water usage, the diverse types of cooling systems utilized in power plants, and the increasing trend of using non-freshwater resources for electricity generation. Additionally, it explores the crucial role of water in renewable energy production and the challenges associated with water consumption and pollution across various stages of the energy supply chain.

1. Water Use in Power Plants : Withdrawal and Consumption

Water usage in power plants consists of two main components: withdrawal and consumption. Withdrawal involves extracting water from a local source, which may or may not be returned or used elsewhere. Consumption refers to the water lost through evaporation during the cooling process. Some power plants utilize once-through cooling systems, drawing water from various sources to cool steam and returning most of it, albeit at higher temperatures.

> *Coal and nuclear plants can withdraw 20 to 60 gallons of water per kilowatt-hour of electricity produced, depending on their cooling methods*

Due to this approach, electric power generation accounts for nearly 40% of freshwater withdrawals in the United States, around 100 billion gallons daily in 2008, mostly for cooling purposes.

2. Overview of Diverse Cooling System in Power Generation

There are various types of cooling systems used in power plants, including wet cooling systems (such as once-through and closed-loop systems), dry cooling systems, and hybrid systems. It highlights the water usage differences between these systems and the sources from which water can be obtained for cooling purposes, the

increasing use of non-freshwater resources for power generation and the importance of proximity to water sources and environmental regulations. Additionally, the lack of comprehensive information on the current deployment and future trends of different cooling system types in the electricity sector.

3. Water's Role in Renewable Energy Production

Water resources play a vital role in the entire process of renewable energy production. From the sourcing of energy supplies, transportation, construction and operation of power plants, electricity generation, distribution, to waste disposal within the supply chain, all these stages are directly or indirectly linked to water usage and pollution.

> *"The levels of water consumption or wastewater generation at these stages can vary across different types of renewable energy sources"*

While the operational phase of wind power has minimal water consumption, the construction and transportation phases of windmills require relatively large amounts of water. In the case of hydropower plants, the evaporation from the reservoir during operation stands out as a significant stage in water consumption.

To provide more accurate and comparable results, a comprehensive life cycle water footprint assessment should encompass all these stages. Due to significant data limitations, many studies often restrict the system boundary to the "cradle to gate" level, covering the entire process from raw material collection to electricity generation per unit (e.g., 1 kWh). The specific water consumption (SWC) of renewable power generation, including hydropower, solar photovoltaics, wind power, and geothermal energy, varies based on different system boundary settings and geographical areas. For instance, the water footprint / SWC of hydropower ranges from 0.2 to 245 L/kWh (as indicated in Table 1) depending on the system boundary chosen.

Table 1: Summary of SWC of electricity generation from renewable energy sources

Type of renewable energy sources	SWC/Water footprint	Functional Unit	System boundary	Covered geographical area
Hydropower				
Mielke et al. (2010)	17.0	L/kWh	Operational cooling water	World average
Macknick et al. (2012)	17.0			World average
Mekonnen and Huekstra (2012)	245.0	L/kWh	Operation stage blue water footprint	Average of 35 sites covering 8 % of the global installed hydroelectric capacity
Bakken et al (2016)	0.2	L/kWh	Cradle to gate*	Norway
Larsen and Drews (2019)	0.0	Share of fresh cooling water in power generation, %	Operational stage cooling water	EU-28
Solar photovoltaics (PV)				
Macknick et al. (2012)	0.004	L/kWh	Operational stage	World average
Spang et al. (2014)	0.000	L/kWh	Operational stage	World average
Wind				
Saidur et al. (2011)	0.004	L/kWh	Operation stage	Malaysia
Li et al. (2012)	0.64	L/kWh	Life cycle	China
Larsen and Drews (2019)	0	Share of cooling water in power generation, %	Operation stage cooling water	EU-28
Geothermal power generation				
Mielke et al. (2010)	2.5	L/kWh	Operational cooling water	World average
Clark et al. (2011)	1.9	L/kWh	life cycle*	US
Macknick et al. (2012)	6.8	L/kWh	Operational cooling water	World average

4. The Three Gorges Dam : China's Mega Power Project

The Three Gorges Dam, located near Sandouping in Yiling District, Yichang, Hubei province, central China, spans the Yangtze River downstream of the Three Gorges. It is the largest power station globally in terms of installed capacity, generating an average of 95±20 TWh of electricity annually, depending on the river basin's precipitation levels. Following the heavy monsoon rains in 2020, its annual production reached nearly 112 TWh, surpassing the previous record set by the Itaipu Dam in 2016.

> *"Construction of the dam's structure was completed in 2006, with the power plant becoming fully operational in 2012 when all main water turbines in the underground facility commenced production"*

Each of the 32 main water turbines has a capacity of 700 MW, contributing to the total electric generating capacity of 22,500 MW when combined with two smaller generators (50 MW each) powering the plant. Aside from electricity generation, the dam was designed to enhance the Yangtze River's shipping capacity and mitigate downstream flooding risks that historically affected the Yangtze Plain. While China views the project as a significant social and economic achievement, concerns over ecological impacts like increased landslide risks have sparked controversy both domestically and internationally.

5. Itaipu Dam : A Binational Hydroelectric Marvel

The Itaipu Dam, situated on the Paraná River at the border between Brazil and Paraguay, ranks as the world's third-largest hydroelectric dam, boasting the 45th largest reservoir globally. Its name, "Itaipu," originates from a nearby isle, translating to "the sounding stone" in the Guarani language. By 2020, the Itaipu Dam's hydroelectric power plant stood as the second most prolific electricity producer worldwide, surpassed only by China's Three Gorges Dam.Constructed in 1984, this binational project overseen by Brazil and Paraguay lies along the border, 15 km north of the Friendship Bridge. Extending from Foz do Iguaçu in Brazil to Ciudad del Este in Paraguay in the south, and to Guaíra and Salto del Guairá in

the north, the plant boasts an installed generation capacity of 14 GW. With 20 generating units each producing 700 MW and a hydraulic design head of 118 meters, the plant employed 3038 workers in 2016. Among the twenty generator units, ten operate at 50 Hz for Paraguay, while the other ten run at 60 Hz for Brazil. Given that Paraguay's generators exceed local demand, most of their output is exported to Brazil. Two 600 kV HVDC lines, approximately 800 kilometers long each, transmit the energy to the São Paulo/Rio de Janeiro region, where it is converted to 60 Hz for distribution.

6. Gabal El-Zeit Wind Farm : Pioneering Renewable Energy Hub

The facility is situated on the western side of the coastal road in Hurghada, within District 3 of Gabal El-Zeit. The wind farm at Gabal El-Zeit comprises three projects, housing a total of 390 wind turbines with a combined capacity of 580 megawatts (MW). This makes Gabal El-Zeit power plant the largest station globally in terms of area, number of turbines, and generated capacities. Spanning 100 square kilometers, the wind station has a total capacity of 580 MW, with each turbine producing 2 MW.

> *"The initial project features 120 turbines, the second has 110, and the third consists of 60"*

The station is equipped with a bird migration monitoring system using radar to halt turbines when birds pass through, resuming operation once they have cleared, a pioneering system globally. It comprises three administrative buildings, including the control room building designed to international standards and equipped with cutting-edge technology for simultaneous monitoring of all turbines and connection to the national power grid. The turbines at Gabal El-Zeit plant represent the latest technology globally, featuring electric elevators for easier maintenance. Gabal El-Zeit's location is considered one of the prime sites worldwide for investing in wind power projects due to wind speeds ranging from 12 to 33 meters per second and the flat terrain devoid of curves or rocks.

7. Conclusion

water plays a crucial role in power generation and renewable energy production. Understanding the water requirements of different cooling systems, the sources of water used, and the environmental implications is essential for sustainable energy development. As the world transitions towards cleaner energy sources, it is imperative to address water consumption and pollution issues throughout the lifecycle of energy production to ensure a more sustainable and environmentally friendly future.

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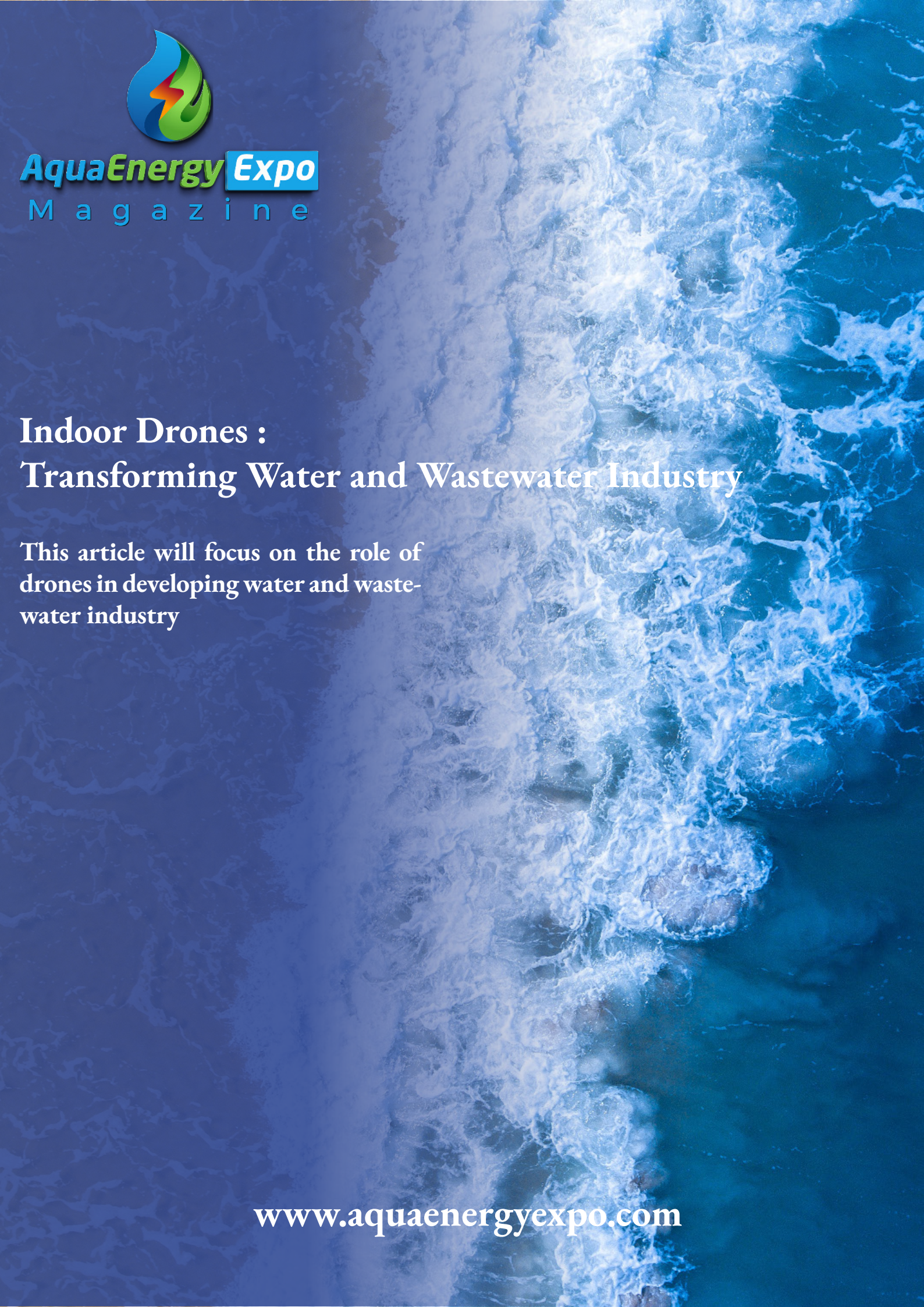

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Indoor Drones : Transforming Water and Wastewater Industry

This article will focus on the role of drones in developing water and waste-water industry

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Indoor Drones : Transforming Water and Wastewater Industry

Indoor drones are revolutionizing the water and wastewater industry in several ways. Indoor drones are unmanned aerial vehicles (UAVs) capable of flying and operating in confined and indoor spaces, such as pipes, tanks, and basins. They are equipped with sensors, cameras, and other tools that enable them to perform various tasksincluding inspection, testing, sampling, leak detection, water quality monitoring, asset management, and emergency response. These drones can navigate confined spaces and collect data with precision, improving efficiency and reducing costs. They are equipped with advanced sensors and cameras to detect leaks, assess the condition of infrastructure, and monitor water quality. Indoor drones are transforming how the water and wastewater industry operates, improving safety, faster response times, and improving resource management.

1. Enhancing Sewer Infrastructure Management with Drones

1. 1 Safety

The management of water and wastewater poses various risks, such as hazardous gases and inaccessible structures in underground infrastructure. Working in this environment can be dangerous. Inspectors face significant dangers during confined space access for sewage inspections, including exposure to poisonous gases like hydrogen sulfide, poor visibility, slippery areas, and the risk of infrastructure failure. Using indoor drones for remote visual inspections of manholes and sewer networks can enhance inspection safety by reducing or eliminating the need for inspectors to enter the sewage system.

1.2 Conserving

Drones provide fast deployment with minimal setup time, unlike traditional methods that need heavy equipment and preparation. They can be operational within minutes, avoiding delays associated with manned entry setups. Drones reduce disruptions by flying overhead without causing traffic congestion, unlike traditional inspections that can disrupt regular activities. With fewer workers required for drone inspections, often controlled by a single remote pilot, efficiency is improved compared to traditional methods involving multiple personnel. Drones are highly mobile, covering large areas quickly in sewage networks, outpacing manual inspections limited by physical constraints. For instance, drones can inspect 900 meters per day, over twice as fast as traditional methods covering only 400 meters daily on average.

1.3 High Quality Data

Drones provide stunning imagery with high-quality photos and videos, surpassing CCTV and other

expensive robotic options. Equipped with high-resolution cameras and lighting, drones can capture detailed images even in dimly lit environments, illuminating sewer systems for inspectors. They allow control over camera speed and angle for better inspection of pipes and tunnels. Some drones can utilize LiDAR technology for high-precision 3D mapping of sewage systems, producing accurate models of infrastructure components. The data collected by drones can be processed efficiently with the right software, enabling the creation of detailed reports, maps, and 3D models for research and decision-making. This documentation aids in tracking changes over time and is valuable for long-term planning and maintenance of sewage systems.

1.4 Data Localization

Sewer system inspections play a vital role in network maintenance by helping inspectors identify pipe obstructions, assess functional capacity, detect structural issues, and pinpoint conduit positions for repairs. Localizing points of interest involves using drones to pinpoint problems during culvert inspections like collapses, cracks, or debris buildup. Drones can also identify pipes needing repair in the wastewater collection system, aiding in maintenance work and planning by providing accurate location data on a map portal. These inspections are essential for ensuring the proper functioning and integrity of sewer systems, highlighting areas that require attention and preventive maintenance measures.

1.5 Improved Inspection Capabilities

Improved inspection capabilities through the use of drones offer several benefits. Regular drone inspections help in early detection of potential issues in pipes, sewers, and assets, allowing municipalities and utilities to address maintenance needs proactively. Drones can enter sewers without the need for pipe hydrocuring or agents entering the pipe, simplifying inspection deployment and repetition. In case of sewer emergencies, drones can significantly reduce response time by providing real-time data for inspectors to make quick decisions and prioritize maintenance or repairs. Drones make inspection more accessible by reaching areas difficult to access manually or with traditional equipment, eliminating the need for entry into confined spaces. This technology is particularly useful in urban areas with limited access points, as drones can be flown safely from above ground, saving time and avoiding potential hazards.

2. Innovative Water Testing from Drones Over Water

Drones Over Water is a company that offers drone-based solutions for water testing and monitoring. The company uses drones equipped with sensors that can perform water tests in various locations, such as pipes,tanks, and oil spills. The drones can collect data such as pH, conductivity, and temperature, and transmit it in real-time to a cloud platform. The data can then be analyzed and visualized by the clients, who can use it for various purposes, such as water quality assessment, leak detection, environmental compliance, and emergency response. Drones Over Water aims to provide a fast, accurate, and cost-effective way of collecting water data, while reducing the risks and challenges associated with traditional methods.

3. Melbourne Water's Innovative Drone Projects for Infrastructure Enhancement

Melbourne Water is a utility that manages and protects Melbourne's major water resources on behalf of the community. It is responsible for providing water supply, sewerage, waterways, drainage, and flood management services. Melbourne Water has undertaken several projects that use indoor drones to improve its operations and infrastructure as following :

3.1 Wastewater Treatment Plant Inspection :

Melbourne Water uses drones to inspect its wastewater treatment plant infrastructure, such as pipes, valves, and pumps. The drones can reduce the time, cost, and risk of traditional inspection methods, and provide high-quality footage and data. The drones can also access hard-to-reach areas and detect defects and leaks.

3.2 Sewer Network Laser Scanning :

Melbourne Water uses drones and laser technology to improve its sewer network. The drones can fly inside the sewers and use laser scanners to create 3D models of the pipes. The models can help identify problems such as cracks, blockages, and corrosion. The drones can also measure the flow and capacity of the sewers.

4. Exploring the Depths with Underwater Drones

Underwater drones are autonomous underwater vehicles (AUVs) that can dive and operate in water environments, such as lakes, rivers, and oceans. They are equipped with sensors, cameras, and other tools that enable them to perform various tasks such as exploration, inspection, mapping, and sampling. Underwater drones have many applications in different fields, such as marine science, environmental monitoring, defense, and industry. The global underwater drones market size was worth USD 4,545 million in 2021. It is projected to reach USD 12,500 million by 2030, growing at a CAGR of 11.9% during the forecast period (2022–2030). Here are some examples of underwater drone projects that are currently underway or planned :

4.1 National Geographic's Open ROV

This project aims to accelerate marine discoveries by providing underwater drones to citizen scientists, nonprofit organizations, and classrooms. The drones can be used to investigate and document various marine phenomena, such as coral reefs, fish spawning sites, giant pine scale infestations, and underwater volcanoes.

4.2 Ukrainian Project FURY

This project seeks to introduce highly capable Western underwater drones to the fight against the Russian Navy in the Black Sea. The drones can be armed with torpedoes or missiles and can target Russian warships and submarines. The drones can also provide intelligence and reconnaissance for the Ukrainian Navy.

4.3 Bard College's Center for the Study of the Drone

This project conducts research and analysis on the de velopment and use of underwater drones, especially in the military and security domains. The project also provides educational resources and publications on the history, technology, and policy of underwater drones.

5. Enhancing Sewer Networks with Laser Technology and Drones

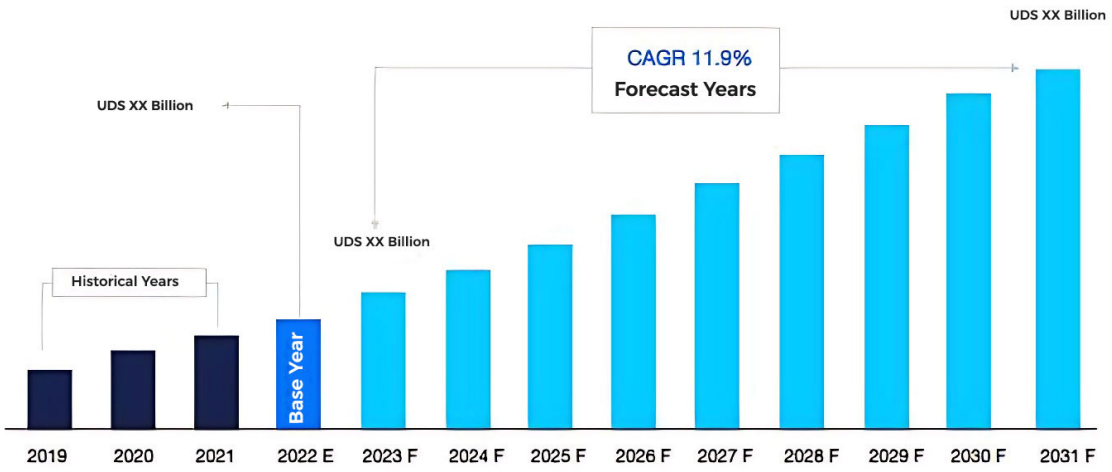
Laser technology is the use of light amplification by stimulated emission of radiation (laser) to produce coherent, high-intensity beams of light that can interact with various types of matter. Laser technology has many applications in different fields, such as science, industry, medicine, communication, and defense. One of the projects that uses laser technology in the water and wastewater industry is the following :

5.1 Sewer Network Laser Scanning

This project, carried out by Scottish Water and its partners, uses drones and laser technology to improve its sewer network. The drones can fly inside the sewers and use laser scanners to create 3D models of the pipes. The models can help identify problems such as cracks, blockages, and corrosion. The drones can also measure the flow and capacity of the sewers. This project can reduce the time, cost, and risk of traditional inspection methods, and provide high-quality footage and data. It can also help Scottish Water to make better decisions on investment and maintenance, and reduce the carbon emissions from sewer surveys. This project is considered to be the UK's first high-power firing of a laser weapon against aerial targets.

6. Conclusion

Indoor drones are a game-changing technology that offers many benefits for the water and wastewater industry. They can help water and wastewater utilities to improve their operations, efficiency, quality, and sustainability. By using indoor drones, utilities can reduce the risks and costs associated with traditional methods of inspection, monitoring, testing, and sampling. They can also gain more data and insights that can help them make better decisions and optimize their processes. Furthermore, indoor drones can enhance public awareness and education of the water and wastewater industry, as they can showcase the challenges and solutions of this vital sector.



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UV Technology Drives a Sustainable Transformation in Key Industries by 2024

UV technology has been widely recognized as an effective method for disinfection in various water applications, harnessing the natural disinfection action of the sun's rays. With enhanced technological and design configurations, UV systems have become a practical and sustainable solution for water treatment, offering consistent water quality before and after treatment. The short reaction time between UV irradiation and the organism to be inactivated, along with the absence of harmful by-products, make UV technology the preferred solution in a wide range of water treatment applications.

1. UV Technology : A Sustainable Solution for Water Disinfection

UV technology has been extensively utilized for over a century and is now widely acknowledged as an effective method for disinfection across various water qualities and applications. Enhanced technological and design configurations have made UV a practical solution for both operational and capital expenses in disinfection processes, as well as in more advanced applications like Advanced Oxidation Processes (AOP).

This sustainable method harnesses the natural disinfection action of the sun's rays, with UV systems producing ultraviolet germicidal rays thousands of times stronger. This makes ultraviolet technology an accepted global solution for water disinfection, effectively ensuring consistent water quality before and after treatment.

> *"The short reaction time between UV irradiation and the organism to be inactivated, along with the absence of any by-products, are key advantages that make UV technology systems the preferred solution in a wide range of water treatment applications"*

The radiation dose or fluence is a crucial design parameter for the disinfection effect of UV irradiation, with the necessary dose depending on the organism to be killed and expressed in mWs/cm^2 and/or mJ/cm^2. UV Transmission measures the UV light's ability to pass through 1 cm of liquid, with water absorbing some of the radiation, resulting in decreased light intensity from the lamp.

2. Transforming Industries for a Sustainable Future

The UV technology sector, a key player in areas such as water treatment and disinfection in the food and beverage industry, is set to undergo a shift in 2024 and beyond. Although the industry may not see groundbreaking technological revolutions, it is adjusting to emerging trends that will have a substantial impact on its future. Some important examples are presented here :-

2.1 UV Technology's Role in Sustainable Aquaculture

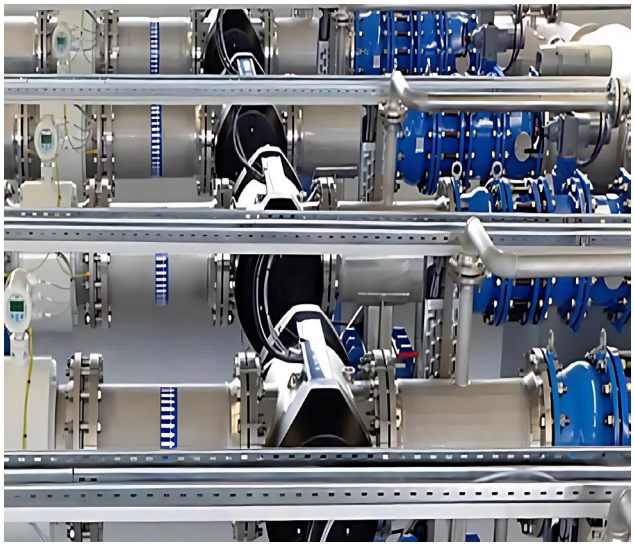
Fish is one of the most globally consumed foods, and its popularity continues to grow. 2022 global fish production reached a staggering 184.6 million metric tons, a significant increase from the 178.1 million metric tons reported in 2021. However, there is also a rising demand for sustainable seafood. For this reason, land-based fish farming, known as aquaculture, is currently undergoing a resurgence, and UV technology is central to its success.

From small-scale local operations to massive commercial fish farms, UV technology ensures the cleanliness of the water, ridding it of parasites and harmful microorganisms that can jeopardise the fish's health and the product's quality. As the global appetite for seafood consumption continues to expand, the role of UV technology in maintaining fish health, securing public health, and bolstering local food supplies becomes increasingly apparent. This trend is set to persist, emphasising the pivotal role of UV technology in supporting a sustainable and healthy aquaculture industry.

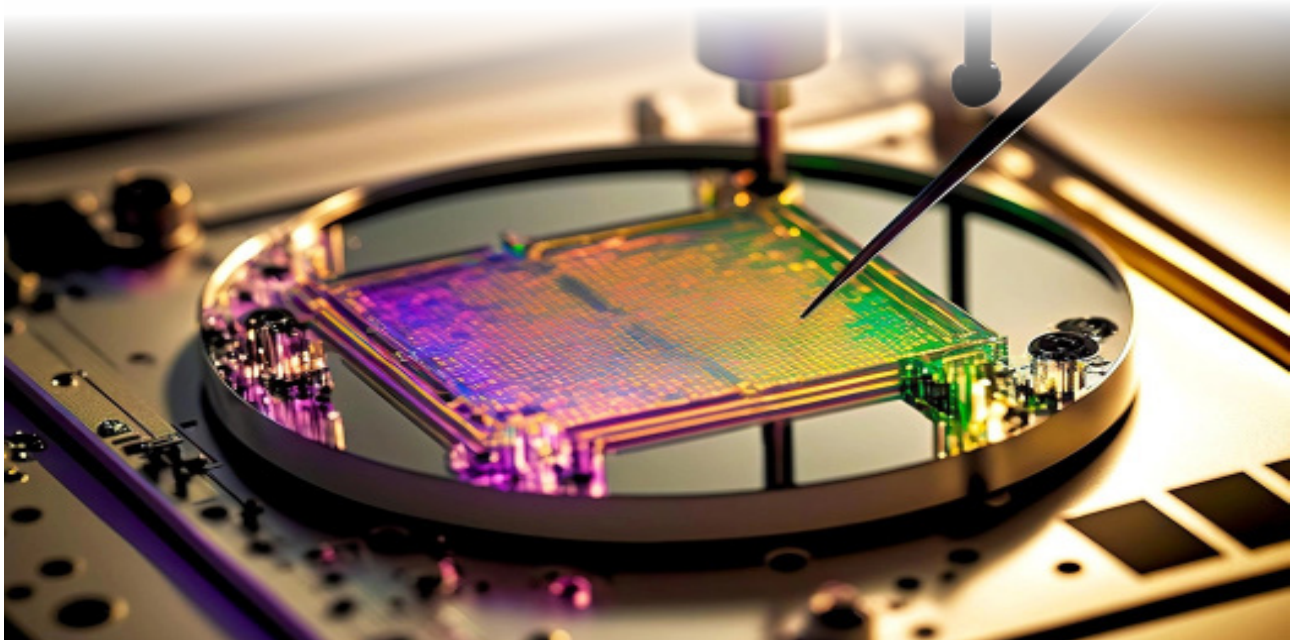
2.2 UV Technology's Impact on Semiconductor Industry

The semiconductor industry, particularly in microelectronics production, is experiencing a growing demand for UV technology. The increasing need for chips and semiconductor fabrication driven by the digital revolution has led to the essential role of UV technology. It is crucial in eliminating Total Organic Carbon (TOC) from water used in chip fabrication, ensuring the quality and safety of microelectronics like computer chips and wafers. This heightened demand is projected to continue for the next two to three years, propelled by the relentless demand for digital technologies, AI, and IoT devices.

2.3 UV Tunnels in Surface Disinfection



UV tunnels, while not a completely novel idea, are becoming more widely recognized and utilized across different industries. These tunnels are created to sanitize surfaces, such as pallets and equipment, to prevent any cross-contamination when transitioning between different areas. Although the demand is not skyrocketing,



there is a growing interest and increasing demand for the use of UV tunnels for surface disinfection. This trend demonstrates the industry's flexibility and adaptability in meeting current requirements.

3. Global Market Trends in UV Disinfection Equipment

The 2022 global market size for ultraviolet disinfection equipment was valued at USD 3,629.3 million and is projected to grow at a compound annual growth rate (CAGR) of 6.9% from 2023 to 2030. The growing demand for ultraviolet (UV) disinfection equipment in healthcare institutions is expected to drive industry expansion. The supply of this equipment and its components has been affected by the COVID-19 pandemic, as manufacturers are unable to meet the increasing demand and have reached their maximum production capacity.

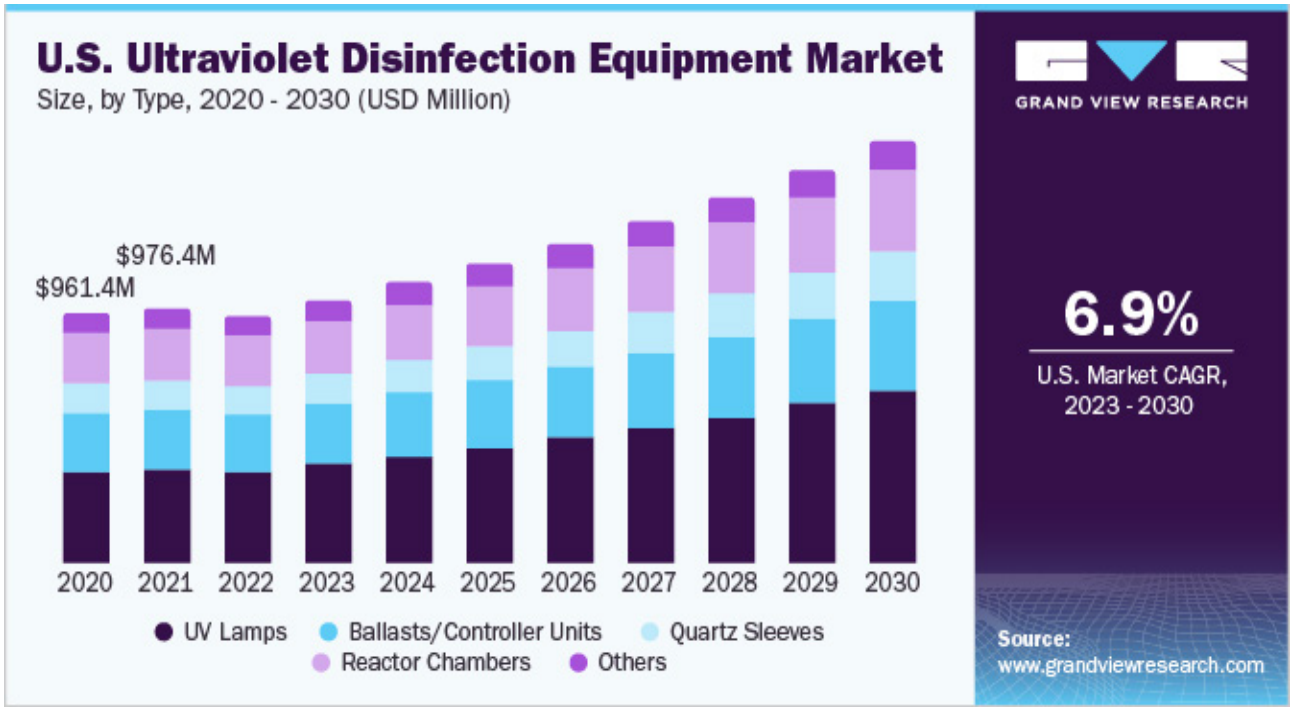
These companies will need to expand their manufacturing facilities to meet the growing demand from end-users, which cannot be accomplished in a short period. The UV lamps segment dominated the market in 2022 with a revenue share of 36.9%. Various types of UV lamps, such as low-pressure bulbs and amalgam lamps, are driving industry expansion due to their effectiveness in different applications. The accumulation of various substances can cause quartz sleeve fouling, leading to increased demand for replacement. Reactor chambers are expected to experience steady growth due to their high flow capacity, easy installation, and low head losses. Electronic ballasts, known for their efficiency and compact size, are anticipated to boost demand for UV disinfection equipment.

4. Promising Future of UV Technology in Water Treatment

The future of UV technology in the water sector is promising due to increasing concerns about water quality and environmental sustainability. Advancements in UV technology and design configurations have made UV systems more efficient and cost-effective for water treatment. UV technology offers consistent water quality ,Ongoing research and development will likely further enhance the effectiveness and efficiency of UV technology, solidifying its role as a sustainable solution for water disinfection.

5. Conclusion

The future of UV technology in the water sector is promising, driven by increasing concerns about water quality and environmental sustainability. As the industry adapts to emerging trends and shifts in various sectors such as sustainable aquaculture, semiconductor production, surface disinfection, and global market trends in UV disinfection equipment, UV technology is positioned to play a pivotal role in supporting a sustainable and healthy future. Ongoing advancements and ongoing research and development will likely further enhance the effectiveness and efficiency of UV technology, ensuring its continued role as a sustainable solution for water disinfection and beyond.



Addressing Jordan's Water Scarcity : The Aqaba-Amman Water Desalination and Conveyance Project

Faced with severe water scarcity, jordan has less than 100 cubic meters of renewable water resources per person annually, falling well below the 'absolute water scarcity' threshold. Projections indicate that water stress levels will rise, impacting more than 90% of low-income families. Nevertheless, policy choices have the potential to alleviate this crisis. The Aqaba-Amman Water Desalination and Conveyance Project aims to tackle this issue by producing 300 million cubic meters of desalinated drinking water annually, with international support. Implementing interventions on both the supply and demand sides can significantly reduce water stress and its impacts on society and the economy.

1. Quenching Jordan's Thirst

The Aqaba-Amman Water Desalination and Conveyance Project is a groundbreaking initiative aimed at addressing Jordan's severe water scarcity. With less than 100m3 of freshwater per person annually, water is rationed in many parts of the country. However, the project, set to be completed by the end of 2028, plans to desalinate water from the Red Sea and transport it 450 kilometers north to Amman, providing 300 million cubic meters of water annually. The World Bank has approved this historic agreement, which is seen as a solution to Jordan's water deficit and the environmental degradation of the Dead Sea. Despite previous plans to connect the two seas, no action was taken. The Dead Sea's water level has dramatically decreased, and environmental groups argue for rehabilitating the Jordan River to address the root cause of the problem. The project has received both praise and criticism, with some touting it as a sustainable solution and others advocating for alternative approaches to preserve the region's water resources.

2. World's Largest Desalination Plant

The preferred method for importing water from the Red Sea involves building a pumping station near Aqaba and constructing the world's largest desalination plant. The plant's capacity would start at 320 million m3/year and rise to 850 m3/year by 2060, requiring increasing power. Post-desalination high-salinity water would be piped to the Dead Sea to halt its shrinkage, and a hydroelectric plant would provide electricity to Jordan, Israel, and the Palestinian Authority. The World Bank's study program indicates that potential environmental and social impacts can be mitigated to acceptable levels.

3. Limiting Environmental Impact of Desalination and Pipeline

Desalinating water and transporting it across the country is an environmental challenge. The European Investment Bank's environmental and social impact assessment of the project took two years, because extensive surveys had to be conducted to properly assess potential harm to the environment. As a result, the project will :

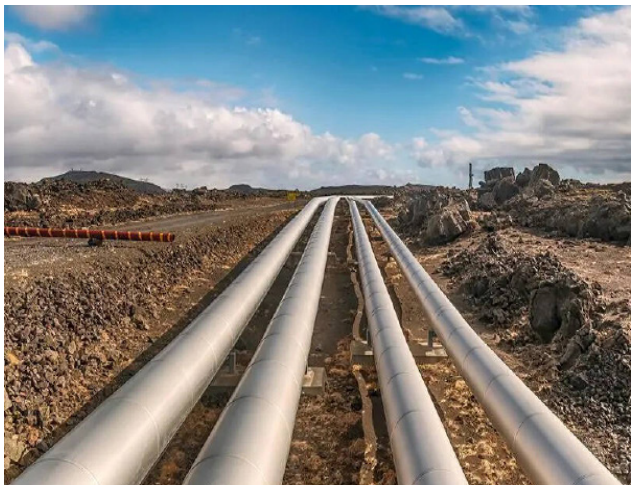
- Take in seawater without destroying marine life, such as reef larvae. The consultants found that the larvae stay at a specific depth and can be avoided if the desalination plant draws in water at a different depth, at a limited velocity, and over a large surface.
- Eject none of the chemicals used in the desalination process back into the sea. For this, a wastewater treatment plant will be incorporated into the desalination plant.
- Safely dispose of leftover brine, which has double the salt concentration of seawater. A simulation showed that if the brine is shot out into the sea with hoses at a high velocity over a large area, the salt concentration at 20 meters away is just 1% above the normal level, and beyond 50 to 100 meters it is undetectable.
- Power the plant and pump water over 400 km while keeping carbon emissions low. Emissions were capped at the equivalent of 3.2 kg of CO2 per cubic metre of desalinated water.
- Build photovoltaic fields without damaging nature reserves or disrupting the flight path of the 500 million birds that migrate through Jordan every year.

4. Financing the Aqaba-Amman Desalination Project

- Jordan's Ministry of Water and Irrigation (MWI) revealed it would be working with a single bidder to try to find a bankable solution for its $10 billion Aqaba-Amman water desalination and conveyance mega-project. The MWI said a team comprising Meridiam and Suez had submitted the only offer for the project, which is one of the largest water infrastructure schemes in the world.
- USAID and CDM Smith are working on securing Jordan's water supply by making critical water and wastewater infrastructure upgrades. To support the Ministry of Water and Irrigation with the planning and procurement of the project, CDM Smith provides technical, financial, and legal services as USAID's implementing partner for this build-operate-transfer 30-year concession contract. In support of this effort, CDM Smith prepared a concept design and feasibility cost estimate to determine the viability and bankability of treating seawater and a conveyance system from Aqaba to Amman.

> *"The project has also taken on climate change priorities to limit greenhouse gas emissions from the power consumption by introducing a renewable energy generation facility as part of the scope"*

5. Water Scarcity Challenges and Solutions in Jordan



The multinational proposal aims to construct a 180-kilometre pipeline to transport up to two billion cubic meters of seawater annually from the Gulf of Aqaba to the Red Sea through Jordanian territory. Jordan, facing severe water scarcity and hosting a large number of Syrian refugees, supports the Red-Dead canal as a means to address its water shortage. Saad Abu Hamour of the Jordan Valley Authority emphasizes Jordan's commitment to securing potable water through the proposed conduit. However, Munqeth Mehyar of FoEME raises concerns, pointing out that the entire plan takes place on Jordanian territory and expressing doubts about international aid due to the global economic downturn. He also highlights the limited employment opportunities the project would provide. These factors contribute to the complex considerations surrounding the proposed conduit project in Jordan. Jordan has always had very limited groundwater and surface water resources. The natural water scarcity is exacerbated by three main factors :

- Climate change has led to a significant reduction in rainfall and less refilling of aquifers
- Jordan's population has grown rapidly over the past decade, to 11.1 million in 2022 from about 7.1 million in 2011, mainly due to refugee influx. It is expected to reach 16.8 million by 2040

- Non-revenue water, or water that does not reach its intended destination because of leaks, theft, or other reasons
- An agreement to sell renewable energy to neighbour Israel in exchange for access to desalinated seawater looked to offer a lifeline at one point, but negotiations fell through completely after diplomatic relations were broken off in light of he conflict in Gaza.

6. International Support at COP 2028

At the COP 28 climate conference in Dubai, the European Investment Bank (EIB) signed a EUR 100 million loan agreement with Jordan, alongside a EUR 50 million grant from the European Union. This financing supports the Aqaba Amman Desalination and Water Conveyance project, aiming to address Jordan's water challenges exacerbated by climate change. The investment reflects a deep partnership between Jordan and the EIB, aligning with the country's National Water Strategy.

> *"The EIB's commitment to the project now totals EUR 300 million, demonstrating a shared dedication to tackling water scarcity and climate adaptation"*

This significant investment, facilitated by the EU grant, represents a crucial step in enhancing water security and supply for the future of Jordan and its people.

7. Conclusion

- The Aqaba-Amman Water Desalination and Conveyance Project is a groundbreaking initiative aimed at addressing Jordan's severe water scarcity.
- The project, set to be completed by the end of 2028, plans to desalinate water from the Red Sea and transport it 450 kilometers north to Amman, providing 300 million cubic meters of water annually.
- The World Bank has approved this historic agreement, which is seen as a solution to Jordan's water deficit and the environmental degradation of the Dead Sea.
- The multinational proposal aims to construct a 180-Km pipeline to transport up to two billion cubic meters of seawater annually from the Gulf of Aqaba to the Red Sea through Jordanian territory.
- The European Investment Bank (EIB) has committed significant financing, totaling EUR 300 million, to support the project, reflecting a deep partnership between Jordan and the EIB in addressing water scarcity and climate adaptation.

Webuild's $4.7B Deal for Neom's Lake in Saudi Arabia

Saudi Arabia's Neom is a futuristic development project that aims to create a smart city powered by renewable energy and advanced technologies. One of its ambitious plans is to build a mountain resort called Trojena, which will host the 2029 Asian Winter Games and offer ski and water sports facilities. To achieve this, Neom has commissioned Webuild, a leading global construction group, to create an artificial lake and a luxury hotel for Trojena resort. The project of Neom's Lake in Saudi Arabia is one of the largest and most innovative infrastructure projects in the world. This article will provide an overview of the project, its features, and its benefits.

1.Webuild's Visionary Project in NEOM, Saudi Arabia

Webuild, formerly known as Salini Impregilo, is a leading global construction group based in Italy. It specializes in complex infrastructure projects, especially in the water segment. In January 2024, Webuild signed a contract worth USD 4.7 billion (GBP 3.7 billion) with NEOM, a futuristic development project in Saudi Arabia, to create a 2.8-kilometre-long artificial lake and a luxury hotel for Trojena resort. NEOM is a visionary project that aims to create a smart city that will be powered by renewable energy and advanced technologies. It covers an area of 26,500 km² along the Red Sea coast, near the borders of Egypt and Jordan. NEOM is part of the Saudi Vision 2030 program, which seeks to diversify the Kingdom's economy and reduce its dependence on oil exports. Trojena is a mountain destination within NEOM, which will host the 2029 Asian Winter Games and offer ski and water sports facilities. Trojena's masterplan was designed by LAVA, an international architecture firm, and features a sustainable and regenerative approach to the natural environment.

2. Trojena Lake Project : A Modern Oasis under Construction

- The 2.8 km long freshwater lake will be created by three additional dams being built as part of the project. In front of the main dam, there are plans to build a striking building known as "The Bow," which would overlook a valley and have a man-made lake behind it. It will include a hotel, residential sections, and a sizable atrium. Built of roller-compacted concrete (RCC), the main dam will be 475 meters long and 145 meters high, with a capacity of about 2.7 million cubic meters.

- While the third dam, with a capacity of 4.3 million m^3, will be built of rock, the second dam will also be of RCC. Encompassing 1.5 km^2, the man-made lake will have an island set aside for walks and botanical dives.

- Webuild said that it anticipated 10,000 workers—both direct and indirect—would be engaged in the building project.

- Trojena's goal to provide "clean, serene outdoor mountain living, to become a global hub for water sports and entertainment" was restated by Webuild in a statement.

- Neom's total expenses are anticipated to exceed half a trillion dollars as part of the Kingdom's efforts to diversify its revenue streams away from the export of petrol and oil.

- The project has generated criticism because of the way the Saudi Arabian government treats indigenous people, in addition to the enormous financial amounts and ambitious engineering involved. Pietro Salini, CEO of Webuild, said: "We are really honoured to have been given this significant project at NEOM.

- At the lake site, we have already excavated around three million cubic meters, and we still remove 90,000 cubic meters of rock every week. "It is significant that we are employing a sustainable strategy by repurposing all of the rock that was removed for the construction of dams and the lining of lakebeds. This is an important phase in the project's overall growth, so we're happy to see construction start".

- "The lake project at Trojena will be of great interest to those with an interest in dam engineering, safety, and breach modelling like us at HR Wallingford," remarked Craig Goff, technical director of HR Wallingford, in response to the project. This is a massive project, therefore I anticipate that innovative models and risk assessments will be used throughout the design process to benefit the industry as a whole. The project is expected to be completed by 2029

3. Conclusion

- Webuild's project to build an artificial lake and a hotel for Neom's Trojena resort is a remarkable example of engineering and construction excellence, as well as a visionary attempt to transform the Saudi desert into a sustainable and regenerative destination.

- The project, which is expected to be completed by 2029, will employ more than 10,000 people and will be part of the Saudi Vision 2030 programmer for economic diversification.

- The project will also enhance the socio-economic development and environmental sustainability of the region, as well as offer a unique experience for tourists and residents alike.

- Webuild's project is set to be an international marvel and a testament to the potential of human creativity and innovation.

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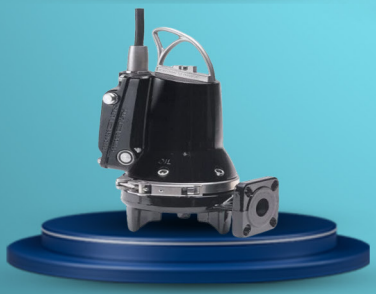
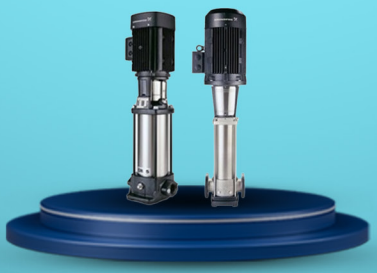


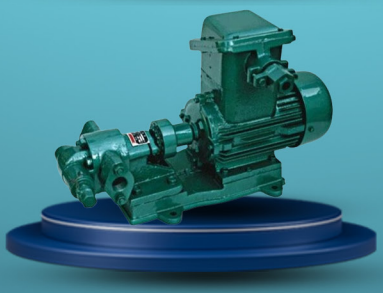

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WATER NEWS BRIEF
March, 2024

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Xylem Partners Globally to Expedite Advancements in Water Security in 2023

In 2023, Xylem and its partners collaborated with various nonprofits like Americares, Mercy Corps, and UNICEF to address the global water crisis through their corporate social responsibility program, Xylem Watermark. The initiative engaged volunteers from 56 countries who dedicated over 183,000 hours to provide water access and education in underserved communities. By combining expertise, technology, and cross-sector collaboration, Xylem Watermark responded to 30 disasters worldwide, offered humanitarian aid, and supported over 1,000 organizations working on water-related causes. Through these efforts, Xylem aims to achieve its 2025 Sustainability Goals by enhancing water security, providing access to clean water and sanitation for millions, and contributing to water-related causes and education.

About 70 Million Individuals are Affected by Harmful PFAS in Drinking Water Across the United States

The EPA recently confirmed that 70 million people have drinking water contaminated with PFAS, based on only one-third of public water supplies. The Biden administration is urged to establish first-time drinking water standards for PFAS. The latest data reflects tests conducted in 2023, with PFAS present in 33% of systems tested. The proposed PFAS drinking water standard will set limits for six PFAS linked to serious health harms. The full scale of PFAS contamination is likely much more widespread than reported. PFAS are known as forever chemicals and have been linked to serious health risks. It is recommended to use a filtration system at home if PFAS are suspected in tap water.

AfDB and OCP Approve $188 Million Water Project in Morocco

The African Development Bank and the OCP Group signed $188 million in loan agreements to fund the Green Investment Program for clean drinking water supply in Morocco. The program includes building three desalination plants, supported by the African Development Bank and the Canada–African Development Bank Climate Fund. These plants will provide 110 million m3 of water annually, benefiting 1.5 million people. The Clean Technology Fund will finance energy storage systems for the plants. This initiative aims to combat climate change, aid vulnerable communities, and create jobs, aligning with Morocco's Emergency Plan for Drinking Water Supply. The partnership between the African Development Bank and Morocco is strengthened, with the OCP Group targeting sustainability objectives like unconventional water use, renewable energy, green ammonia production, and carbon neutrality by 2040, supported by the Canadian government's involvement in addressing climate challenges.

EPA to Allocate $5.8 Billion from Infrastructure Legislation for Water Initiatives

The Environmental Protection Agency (EPA) recently disclosed data indicating that 70 million individuals are exposed to drinking water contaminated with PFAS, or "forever chemicals." This revelation, based on tests from just a fraction of public water systems, underscores the pressing need for the Biden administration to establish national drinking water standards for PFAS. The EPA's latest findings, part of the Fifth Unregulated Contaminant Monitoring Rule (UCMR5), showed PFAS presence in 33% of tested systems in 2023. With PFAS linked to severe health risks, including cancer, immediate action is imperative. While some states have set their own standards, a national standard is crucial to safeguard public health. The EPA's ongoing monitoring and the urgent call for stringent regulations highlight the widespread PFAS contamination crisis and the imperative for protective measures.

ACCIONA Heads the Consortium Constructing the New Alkimos Desalination Plant in Perth, Australia

An ACCIONA-led consortium, chosen by Water Corporation, will construct the Alkimos Seawater Desalination Plant in Perth with an initial capacity of 150,000 m^3 per day, expandable to 300,000 m^3. This project is part of an AU$ 2.8 billion program to provide water to millions. The alliance prioritizes safety, well-being, and sustainability. The plant will address declining rainfall and the growing population, crucial as Perth's population is projected to reach 3.5 million by 2050. ACCIONA, a key player in Australia's infrastructure sector since 2002, has undertaken significant projects like the Adelaide desalination plant and the Mundaring Water Treatment Plant. Additionally, ACCIONA is involved in various large infrastructure projects across Australia, including tunnel construction, electricity transmission lines, and railway developments..

The Kingdom of Saudi Arabia Wins the Hosting of the Eleventh Session of the World Water Forum 2027

The Kingdom of Saudi Arabia has successfully secured the hosting rights for the 11th session of the World Water Forum in Riyadh, showcasing its commitment to water resource sustainability and improving quality of life. Despite being a water-scarce country, the Kingdom's modern infrastructure, regulations, and legislation played a crucial role in winning the bid over Italy. The Minister of Environment, Water, and Agriculture highlighted the Kingdom's victory as a significant milestone in achieving its development and societal goals. The National Water Strategy serves as a roadmap for future endeavors, emphasizing comprehensive frameworks, operational plans, and water conservation efforts. The World Water Forum, organized by the World Water Council, serves as a global platform for collaboration among governments, organizations, and specialists to ensure sustainable water management and universal access to clean water.

Eventful Beginning for the New Chief Financial Officer at Pennon Group

The new Chief Financial Officer, Steve Buck, who recently joined Pennon Group, is well-versed in handling major acquisitions like the purchase of SES Water. With a background in finance, treasury, and transformation from his previous role at Anglian Water Group, along with experience in regulated utilities and the energy sector, Steve is poised to lead the smooth integration of SES into Pennon. His expertise will be crucial as Pennon works with regulators to finalize the acquisition process over the next year. Steve's collaboration with CEO Susan Davy, known for her successful acquisitions at Pennon, signifies a strategic move in line with the company's growth strategy under Susan's leadership, following past acquisitions of Bournemouth Water and Bristol Water.

EWEC Strives for Emission-free Water Production in Abu Dhabi

EWEC, a key player in water and electricity supply in the UAE, is driving a significant shift towards sustainable energy solutions. Their strategic plans focus on decarbonizing water production through advanced technologies like reverse osmosis (RO) plants, aiming for nearly emissions-free water by 2031. Additionally, EWEC is leading the expansion of solar PV capacity to over 7.5GW by 2030 and recommends adding 1.4GW of new solar PV annually from 2027 to 2037. Through initiatives like battery energy storage and transitioning to cleaner energy sources, EWEC anticipates a 50% reduction in CO2 emissions by the mid-2030s, aligning with Abu Dhabi's goal of 60% renewable and clean energy by 2035.

Black & Veatch Appoints Ian Bramson as Vice President of Global Industrial Cybersecurity

Black & Veatch has appointed Ian Bramson as the Vice President of Global Industrial Cybersecurity, where he will lead the strategy, commercialization, and growth of cybersecurity solutions. Industrial cybersecurity plays a crucial role in protecting assets, data, and processes controlled by Operational Technology networks. With the increasing digitization and connectivity in clients' operations, cybersecurity risks have escalated, emphasizing the critical need for robust security measures. Bramson's extensive experience in cybersecurity, risk management, and digital transformation over 25 years positions him well to address these challenges. His successful track record in cybersecurity consulting further strengthens his capabilities. Bramson highlighted the importance of cybersecurity as a business imperative in today's landscape, emphasizing Black & Veatch's role in providing essential solutions to safeguard clients' operations and data, ensuring the security of the communities they serve.

Metito Will Construct the Kenderli Desalination Plant to Advance Kazakhstan's Water Security Agenda

Metito, along with SMK Atameken LLP, Ak Jol Kurylys LLP, and Caspian HES Consulting LLP, has secured a contract to develop a 50,000 m3/day desalination plant in Kazakhstan's Mangystau region. The Kenderli Seawater Reverse Osmosis (SWRO) Desalination Project aims to address the country's projected water deficits by 2040 due to climate change, population growth, and urbanization. Aligned with President Tokayev's water-saving technology initiatives, the project will utilize Metito's engineering expertise to provide potable water for Zhanaozen city and Kenderli resort. This initiative not only ensures water security but also stimulates tourism, entrepreneurship, and agriculture in the region. Scheduled for construction starting March 2024, the project signifies Metito's strategic expansion plans in Central Asia and their commitment to sustainable economic development through water infrastructure projects.

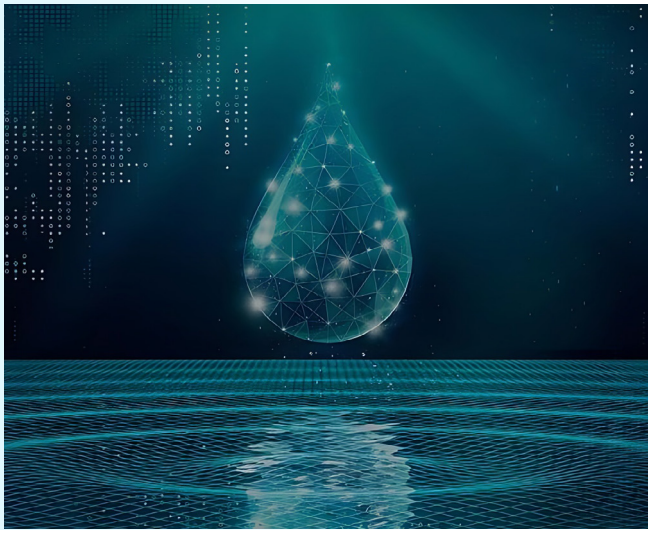
New Hong Kong Desalination Plant Begins Delivering Fresh Water to 137,000 Homes

The new Tseung Kwan O desalination plant, utilizing reverse osmosis technology, has commenced supplying fresh water to 137,000 households in Hong Kong. Constructed over four years starting in December 2019, the plant marks a significant milestone in ensuring a reliable and sustainable water supply amidst challenges like population growth and climate change impacts. Managed by Binnies, the plant's first stage with a production capacity of 135 million liters per day supports Hong Kong's water management strategy for sustainability and security. Plans for the second stage and future expansion demonstrate a commitment to meeting increasing demand and enhancing climate resilience. Emphasizing energy efficiency and sustainability, the plant incorporates renewable energy sources, water recycling, and conservation measures to reduce environmental impact and ensure long-term water security for Hong Kong.

Henkel Agrees to Purchase Seal for Life Industries.

Henkel has agreed to acquire Seal for Life Industries LLC from Arsenal Capital Partners, a US-based provider of protective coating and sealing solutions for various infrastructure sectors like renewable energy, oil & gas, and water. Seal for Life's global operations and innovative product portfolio generated sales of about 250 million euros in 2023. This acquisition aligns with Henkel's strategic growth agenda, enhancing its Maintenance, Repair, and Overhaul (MRO) platform by integrating Seal for Life's advanced technologies. The addition of Seal for Life's expertise in protective coatings and sealants complements Henkel's existing Adhesive Technologies business. The deal reflects Henkel's commitment to expanding its sustainability-focused offerings in markets like renewable energy and water supply. Seal for Life's solutions, including heat-shrink sleeves and fire protection coatings, are renowned for their effectiveness in safeguarding and enhancing various infrastructure assets, demonstrating a strong fit with Henkel's growth strategy in the MRO sector.

XPRIZE Water Scarcity Competition Launches to Unlock the Abundance of Earth's Seas and Oceans



XPRIZE Water Scarcity, launched by XPRIZE with a $150M investment from the Mohamed bin Zayed Water Initiative, is a 5-year global competition with a $119M prize purse. It aims to drive access to clean water through sustainable seawater desalination solutions. The competition addresses global water stress and scarcity, promoting innovation in desalination technologies to make clean water more accessible and abundant. With a focus on affordability and sustainability, the competition seeks to revolutionize desalination methods to benefit billions worldwide. The initiative aims to tackle water scarcity challenges through cutting-edge breakthroughs, ensuring a prosperous future for people and the environment.

First Investment Contracts for Brine Mining Revealed by SWCC

In early 2024, the Saline Water Conversion Corporation (SWCC) inked agreements for brine mining with Chinese companies and other entities, focusing on joint development and investment opportunities in extracting minerals and desalinating water from brine. Collaborations with international and national firms like Ningxia TB and JSG Alliance aim to enhance local industries, maximize brine water usage, and tap into growth opportunities in end-use markets. SWCC's partnerships are projected to attract significant investments, with expected investments in brine mining reaching SAR 8 billion by 2030. Anticipated revenues for SWCC in the same year are estimated at SAR 1 billion, contributing to a GDP increase to SAR 1.5 billion. SWCC's strategic sponsorship of the International Mining Conference underscores its commitment to innovation in brine mining, aligning with the objectives of Saudi Vision 2030 to boost industry localization, economic growth, and investment attraction.

Connexin Wins UK's Largest Smart Water Metering Contract

Connexin, a UK-based smart technology provider, has been chosen by Essex & Suffolk Water for a significant water metering project in the Essex and Suffolk regions. This agreement marks Connexin's third major win in the smart water metering sector, following successes with Yorkshire Water and Severn Trent Water. The contract involves implementing an advanced water metering infrastructure (AMI) framework, aiming to transition all water meters to "smart" devices by 2035. Connexin's solution includes deploying a LoRaWAN network to facilitate real-time data transfer from smart water meters to analyze consumption patterns and detect leaks efficiently. By installing over a million smart water meters by 2035, Essex & Suffolk Water aims to enhance customer billing accuracy, reduce water wastage, and promote environmental sustainability. This initiative aligns with Ofwat's per capita consumption and leakage targets, contributing to a more efficient and eco-friendly water management system in the region.

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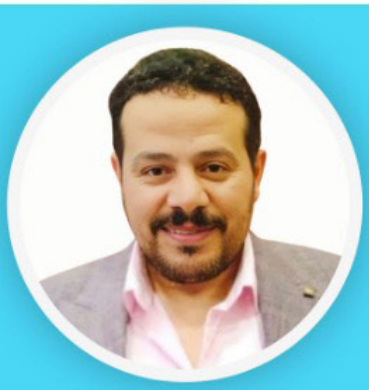

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Eng. Waleed Abu-Elsaud

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- o Design Ultrafiltration Systems Based on Source Water Type
- o Adaptation to Changing Water Quality
- o Comparative Analysis: Differentiation between MBR Systems, Ultrafiltration and Ceramic Filters for Similar Applications.
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- *HAZOP Methodology*
- *HAZOP Ground Rules*
- *Risk Ranking*
- *Study Team*
- *Resources*
- *Recording Software*
- *Study Workshop*
- *Study HAZOP*
- *Recommendations*
- *Risk-Based Recommendations*

Date: Saturday, March 9th

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2- Membrane Normalization

3- Membrane Scaling Calculations

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Date: Saturday, March 16th
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(Saudi Arabia Time)

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Global Water Events

Water & Wastewater Equipment, Treatment & Transport Show

Date: From 24 to 26 Jan 2024
Location: Indianapolis, Indiana

The Water & Wastewater Equipment, Treatment & Transport Show (WETT) is a showcase of the latest innovations within the wastewater industry. The show brings together industry experts, technologies and services. It provides 90+ expert-led courses, live show demonstrations, hundreds of interactive booths and networking opportunities.

Website: wwettshow.com

BRITISH WATER Micropollutants Conference

Date: 8 February 2024
Location: Leeds, UK

British Water will continue the conversation on how micropollutants affect the water sector in the third BW Micropollutants Conference. Our speakers will cover the latest topics on current legislation and ongoing initiatives about the environmental risks associated with micropollutant emissions and treatment approaches.

Website: www.britishwater.co.uk

AOAP Conference and Exposition & NDPA Water Safety

Date: From 12 to 14 Feb 2024
Location: The Grand Sierra Resort and Convention Center in Reno, Nevada

The AOAP Conference and Exposition & NDPA Water Safety Conference is an opportunity for professionals from around the world to earn about the latest trends, legislation, and issues facing our industry. Education, networking & professional development opportunities during the conference are one of a kind.

Website: ndpa.org

WEF/AWWA Utility Management Conference 2024

Date: From 13 to 16 February 2024
Location: Portland, Oregon

The 2024 WEF/AWWA Utility Management Conference offers 6 pre-conference workshops and 36 technical sessions focused on a wide variety of topicsrelated to water and wastewater utility management.

Website: www.wef.org

WEX Global

Date: From 4 to 6 March 2024
Location: Madrid, Spain

WEX Global is a three-day event which brings together the sector's leading experts to discuss water sustainability.

Website: wex-global.com

Membrane Technology Conference

Date: From 4 to 7 March, 2024
Location: West Palm BEeach, Florida

The AMTA/AWWA Membrane Technology Conference explores the latest developments in membrane technology, as it affects water and wastewater treatment. The conference reveals new directions in water and wastewater treatment technologies, desalting and membrane bioreactor applications.

Website: www.awwa.org

The Collection Systems Conference and Stormwater Conference 2024

Date: From 9 to 12 April, 2024
Location: Location The conference will be hosted at the Connecticut Convention Center in Hartford, CT.

The Collection Systems Conference and Stormwater Conference 2024 is an exhibition focused on the design and operations of wastewater collection systems, as well as wet weather control and stormwater management.

Website: www.wef.org

Texas Water Conference

Date: From 9 to 12 April, 2024
Location: NEC, Birmingham, B40 1NT, UK

The conference is celebrating it's 28th year as the Largest Regional Water Conference in the U.S.© Itcaters to professionals in the wastewater and water industry, including water quality engineers, treatment plant technicians and scientists. Also government officials, regulatory agency personnel, manufacturers and their agents, libraries, universities and groups and individuals concerned with protecting public health and the environment.

Website: www.txwater.org

MACH Exhibition

Date: From 15 to 19 April, 2024
Location: NEC, Birmingham, B40 1NT, UK

MACH 2024 is a five-day event where key manufacturing buyers, engineers and manufacturers go to find, specify and purchase new equipment.

Website: www.machexhibition.com

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Iceland's Green Energy Success Story

Energy is a hot topic across the world in 2024, but one famously cool country seems to be getting it right. Nowhere in the world is the power of nature more apparent than it is in Iceland. Volatile volcanoes loom over frozen glaciers giving the country its deserved reputation as "The land of fire and ice". Icelanders have been harnessing this power for more than a century and, today, more than 99.96% of Iceland's electricity comes from renewable sources, with 73% of electricity provided by hydropower plants and 26.8% from geothermal energy.

1. The Transition to Renewables

Although climate change and environmental sustainability have been high on the international agenda lately, Iceland's transition to green energy wasn't triggered by these concerns. In fact, exploration and utilization of these resources happened for mere practical reasons. Iceland used to be one of the poorest nations in the Western world. Thereby, it was unable to sustain oil price fluctuations following a number of crises in world energy markets. To ensure the country's economic growth and stability, it required reliable domestic energy resources, especially in the face of its isolated location on the edge of the Arctic Circle.

2. Geothermal Iceland

Iceland, an isolated island nation, has embraced self-reliance and independence by harnessing geothermal energy and hydroelectricity, which collectively account for 70% and 30% of its energy mix, respectively. Despite the relatively small global share of geothermal energy, Iceland's five plants contribute a significant portion of its electricity and heating needs, serving two-thirds of homes. With a capacity of 755 MW, Iceland ranks in the top 10 globally for geothermal energy production. The country's unique geological features, including over 200 volcanoes, support the use of geothermal energy for greenhouses and district heating, with approximately 90% of homes benefiting from geothermal heating systems. Over the past 25 years, Iceland has seen a remarkable 1700% increase in geothermal utilization, driven by projects like the Iceland Deep Drilling Project, leading to a significant 25% population growth.

Former President Grimsson shed light on Reykjavik's coal smoke-filled past, recalling how the capital was shrouded daily under a black cloud from coal fires. This transformation from pollution to a global leader in clean energy emerged as a beacon of success despite challenging odds.

Today, Iceland stands as the world's largest power producer relative to its population size, with almost 80% of its electricity sold to heavy industries, particularly aluminum smelters operated by Rio Tinto Plc, Century Aluminum Co., and Alcoa Corp. The country's natural conditions of long periods of darkness and cold provide these industries with free natural cooling, further reducing their operational costs.

Regarding the Krafla Magma Testbed (KMT) project, initiated in 2009 by the state-owned geothermal energy company Landsvirkjun as part of the Icelandic Deep Drilling Project, aimed to tap into supercritical water reservoirs above magma flows. Despite challenges during the initial drilling in the remote Krafla Caldera, subsequent funding from the International Continental Scientific Drilling Program and government programs has enabled the KMT to progress towards a testing phase.

The project presents technological challenges due to highly corrosive gas and superheated steam reaching temperatures of 450°C. If successful, the KMT could yield 13 megawatts of geothermal energy, sufficient to power 60,000 homes from just two boreholes over the magma well. The potential breakthroughs in volcanology and geothermal energy technology offered by the KMT could revolutionize energy production and seismic monitoring capabilities.

3. Hydropower in Iceland

Iceland's other main source of energy is hydropower. Contrary to popular belief it is hydropower, not geothermal, that produces the majority of the electricity in Iceland. While it only accounts for 27% of primary energy, this figure is considerably 'beefed up' when transferred to electricity: of the 18 798 GWh produced in 2015, 73% was hydroelectric.

Hydropower harnesses moving water currents to generate electricity, therefore, in order to generate electricity an abundant moving water supply, or a means to move water is needed. Again, Iceland is benefited by its geology and climate, as it is home to numerous waterfalls, rivers, and glaciers.

Moreover, the island is known for its high precipitation, and in 2022 Iceland had a mean precipitation rate of 1287.81 mm, whereas the UK, a renowned 'wet' country, only had 1123.79 mm that same year. Iceland has over 100 years in experience in hydropower usage, with the first station being built in 1904, and replaced imported coal for cooking needs in Reykjavik by 1937. It was in the 1960s that a serious phasing out of fossil fuel generated power was adopted. Presently there are 237 hydropower plants in Iceland.

Landsvirkjun's Fjótsdalur hydropower plant, One such example of the massive hydropower potential in Iceland is Landsvirkjun's Fjótsdalur power plant. Landsvirkjun is the national power company of Iceland, and the largest energy producer in Iceland, generating 73% of the total share. Of the company's 18 plants, 15 are hydropower, which amount to 92% of the company's total electricity production, illustrating the importance of hydropower to Iceland's energy economy.

The aforementioned plant is Landsvirkjun's largest one. The Kárahnjúkar dam built for the station commenced construction in 2003 and involved a process of five dams in two different glacial rivers, that created three separate reservoirs and flooded 440 000 acres of unspoilt highland territory. The station itself became live in 2007, and includes the use of six 115 MW Francis turbines that have an installed capacity of 690 MW and a generation capacity of 4800 GWh/y. While the stats are impressive, this was a cause of serious complaint amongst a lot of locals, and shows the sheer amount of land and water , Iceland has sacrificed to generate this level of power.

4. Wind Energy in Iceland

When visiting Reykjavik, it is abundantly clear right away that the country has a lot of wind, and all the means to produce a robust wind sector. However, there are only two wind turbines on the whole island, which are owned by Landsvirkjun, and only used for research purposes; each turbine only has a capacity of 0.9 MW. It seems odd, however, since the geothermal and hydropower sectors seem to have electricity covered.

Perhaps the potential for wind energy in Iceland could present a possibility for future export ventures. Although the nation has currently satiated its energy needs through hydropower and geothermal means, the untapped wind potential could serve as a valuable resource in generating additional green energy. As advancements in energy storage technology continue, Iceland could look into the option of exporting wind-generated power, creating yet another lucrative revenue stream for the country.

5. Sustainability Lessons from Iceland

Iceland is leading the way in sustainability with its ambitious goal to be carbon neutral by 2040. The country has already phased out fossil fuels in electricity production and house heating, relying heavily on renewable energy sources like geothermal power. Iceland's success in decarbonization serves as a model for other nations, showcasing the benefits of investing in renewable energy and low-carbon technologies to achieve climate goals.

Through collaboration between government, industry, and innovative businesses, Iceland has been able to leverage its natural resources effectively. The country's expertise in geothermal energy has led to significant advancements, with companies like Reykjavik Geothermal exporting their knowledge to other regions with ideal geothermal resources.

> *"Iceland's innovative answers to decarbonisation should give other countries the inspiration to search for solutions"*

Iceland's approach to sustainability emphasizes resilience, innovation, and collaboration. By sharing knowledge and expertise, Iceland demonstrates how each community can reduce carbon-intensive consumption and work towards a more sustainable future. Other countries can learn from Iceland's journey and adapt their strategies to suit their own resources and opportunities, fostering courage and innovation in the pursuit of decarbonization.

Transforming Wastewater Treatment into Sustainable Energy Solutions

In the evolving narrative of wastewater management, treatment plants are no longer seen merely as end-of-pipe solutions. Instead, they are transitioning into resource recovery hubs, epitomizing the principles of a circular water economy. Wastewater treatment plants are becoming resource water plants, extracting valuable resources from wastewater. This transition is laden with multiple environmental and economic benefits. By recovering resources such as water, and energy, (energy use in the water sector largely depends on fossil sources, increasing carbon dioxide (CO2) emissions. Specifically, the water sector accounts for 4% of total energy consumption, with highly energy-dependent wastewater treatment plants (WWTPs) accounting for 25% of the total energy use), these plants are diminishing the environmental footprint of wastewater management while concurrently offering a new avenue for resource generation, fostering economic sustainability.

1. Energy-extracting Wastewater Technologies

Energy-extracting wastewater technologies represent a groundbreaking approach to waste-to-energy technologies, bringing cities closer to energy self-sufficiency in water treatment. These systems ingeniously integrate the processing of sewage and organic waste to produce biogas - a renewable energy source. This reduces the carbon footprint of wastewater treatment plants and adds a layer of sustainability by utilizing otherwise discarded organic waste.

1.1 Algae-based Biofuel Production

Cultivation of algae using wastewater and carbon dioxide emissions from waste facilities, then Algae can be processed into biofuels, including biodiesel and biogas. These Waste-to-Energy technologies offer diverse approaches to managing waste while simultaneously harnessing its energy potential, contributing to sustainable waste management, and reducing our reliance on fossil fuels. The choice of technology often depends on the specific waste stream, environmental considerations, and the desired energy output.

1.2 Anaerobic Digestion: Extracting Energy from Waste

Anaerobic digestion is a process that breaks down organic waste materials, such as sludge, to produce biogas. This biogas can then be converted into electricity and heat to power water treatment plants. Embracing anaerobic digestion not only offers a sustainable energy solution but also provides another avenue for waste management. Its production simultaneously reduces the emissions of greenhouse gases and provides an alternative to fossil fuels. According to the American Biogas Council, there are over 2,200 operational anaerobic digesters in the United States. In Europe, anaerobic digestion plants produced an estimated 14 TWh of electricity in 2020, as calculated by the European Biogas Association.

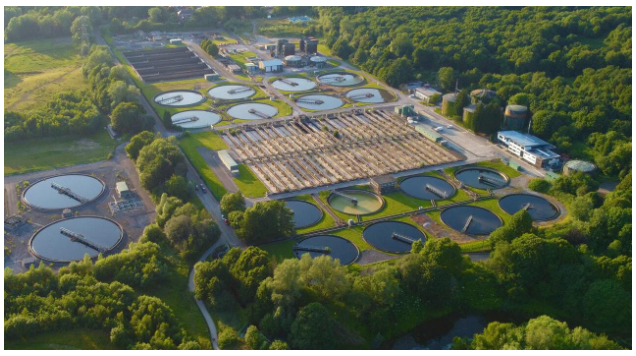
1.3 Hydrothermal Carbonization of Organic Waste

The hydrothermal carbonization process leverages the chemical conversion of organic waste under high heat and pressure. This technique transforms biomass and other organic residues into a carbon-rich material known as hydrochar. The hydrochar can be used as a solid energy source or further processed into valuable biofuels and bioproducts. This circular approach reduces waste and provides an eco-friendly alternative to traditional fossil fuels.

2. Transforming Wastewater Treatment Plants into Green Energy

Wastewater contains significant embedded energy, with five times more energy than needed for treatment. The American Biogas Council reports ~80% of the latent energy in wastewater is thermal, ~20% is chemical, and <1% of the potential exists in hydraulic generation. The International Energy Agency suggests that capturing and digesting waste could provide biogas for millions of households.

An example for this wastewater treatment plants is the Bonneuil-en-France wastewater treatment plant, which was inaugurated by the Syndicat Mixte pour l'Aménagement Hydraulique (SIAH) for the Croult and Petit Rosne Valley region inaugurated which treats wastewater from 35 municipalities in the eastern district of the Val d'Oise department. Veolia, via its subsidiary OTV, led a consortium responsible for designing and carrying out the works, and will operate and maintain the plant until 2027. As well as increasing the plant's treatment capacity and performance, the work, which is being carried out in line with a sustainable development approach, will enable wastewater to be used to produce green energy locally.



The new plant demonstrates the SIAH's commitment to efficient energy management and reducing dependence on fossil fuels. The sludge generated by the purification process is used to produce biogas, which is purified using the MemGas process developed by Biothane, a Veolia subsidiary, before being injected into the existing gas network. This renewable green energy source corresponds to the annual gas consumption of 1,750 new homes heated with gas. The heat produced by the treated water is also recovered using the Energido process to heat the administrative buildings. After treatment, some of the wastewater is reused as industrial water, reducing the pressure on water resources and helping to mitigate the effects of climate change.

The facility incorporates high-performance technologies that enable the Syndicat to comply with current environmental standards while anticipating those of the future. The treatment system installed is both robust and innovative, with at its heart the Hybas biological process developed by AnoxKaldnes, another Veolia subsidiary.

3. Environmental and Economic Benefits of Circular Wastewater Treatment

The advantages of circular wastewater treatment are twofold. Firstly, it significantly reduces the environmental impact by minimizing pollution and conserving resources. Secondly, it introduces economic benefits through the recovery of valuable materials. A study by the World Bank estimates that implementing circular economy principles in wastewater management could result in an economic value equivalent to about 47 billion US dollars annually. By embracing circular economy principles, wastewater treatment plants can become hubs of sustainability, producing clean water while generating energy, and bio-based products. The circular wastewater treatment proposal envisions a cleaner environment and a sustainable resource hub. By recovering nutrients, producing bio-based products, and harnessing energy, we create an autonomous system that benefits the planet and the economy. Converging circular economy principles and wastewater management opens doors to a new era of sustainability and innovation. By treating wastewater as a valuable resource, we transform a conventional process into a dynamic engine of resource recovery, waste reduction, and economic growth.

4. Future Outlook and Potential Developments in this Field

The future outlook and potential developments in transferring wastewater treatment to sustainable energy sources involve exploring innovative ways to convert the energy produced during the treatment process into usable forms. The future wastewater treatment plant encapsulates the circular economy's transformational power. We can address wastewater management challenges by harnessing water, energy, and materials recovery and contribute to a more sustainable and resilient future.

As professionals in the water sector, we must explore, innovate, and collaborate to build a world where every drop of water holds infinite potential. By integrating sustainable energy sources into wastewater treatment processes, we can move towards more environmentally friendly and energy-efficient solutions for managing wastewater. Chemical engineers, water scientists, policymakers, and technology experts should collaborate to develop and implement cutting-edge solutions. Furthermore, advancements in data analytics, IoT, and automation are pivotal in optimizing operations and maximizing resource recovery.

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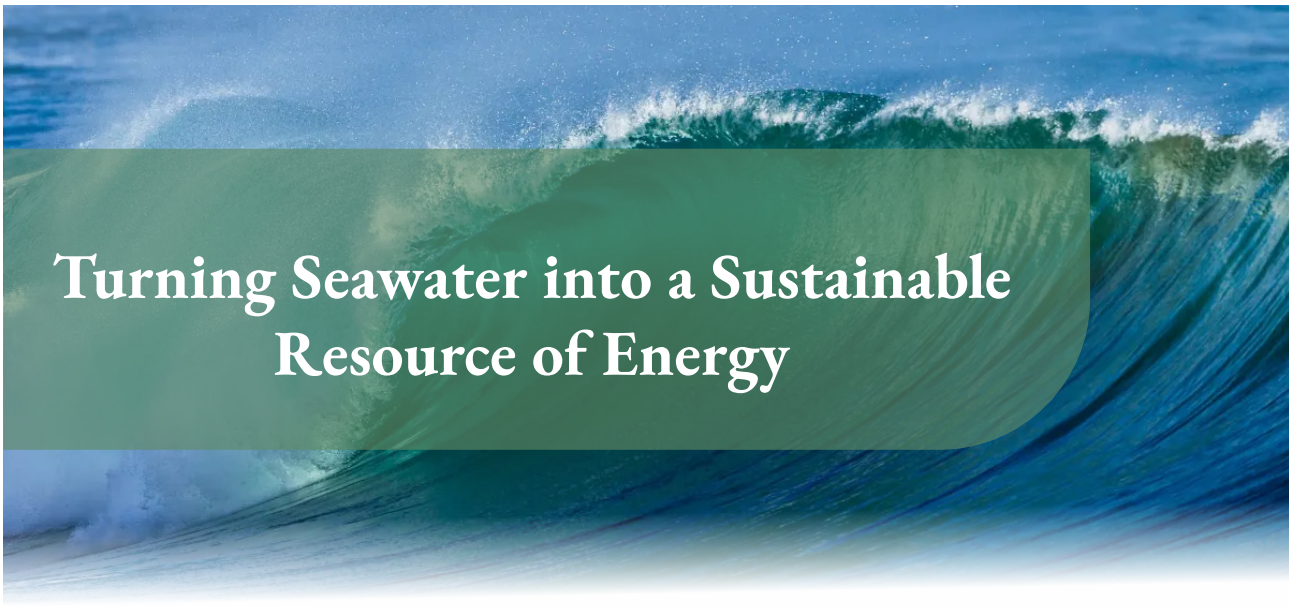


Turning Seawater into a Sustainable Resource of Energy

Green hydrogen has emerged as a promising solution to decarbonize industries and power heavy vehicles without contributing to carbon dioxide emissions. However, the production of green hydrogen has been limited by the high costs associated with electrolyzers and the reliance on freshwater sources. The good news is that researchers from different institutions have made significant advancements in producing hydrogen directly from seawater, opening up the possibility of an abundant and sustainable source of green hydrogen.

> *Seawater electrolysis has been hailed as a wonder technology for creating green hydrogen-seen by some as the fuel of the future*

1. The Challenge of Green Hydrogen Production

Currently, the majority of hydrogen production involves breaking apart methane, which releases carbon dioxide and contributes to climate change. Green hydrogen, on the other hand, is produced by splitting water molecules using renewable energy, resulting in only oxygen and hydrogen. This clean and sustainable approach has the potential to revolutionize various industries and reduce greenhouse gas emissions. However, the cost of producing green hydrogen remains high, primarily due to the expensive catalysts used in electrolyzers and the reliance on freshwater sources. Electrolysis, the process of splitting water, requires a significant amount of water, with estimates suggesting that generating 1 kilogram of hydrogen can consume up to 10 kilograms of water. If green hydrogen were to replace traditional hydrogen production entirely, it could lead to a massive strain on freshwater resources.

For instance, running trucks and key industries on green hydrogen alone could require approximately 25 billion cubic meters of freshwater annually, equivalent to the water consumption of a country with 62 million people.

2. Efforts to Make Salt Water Green Hydrogen Production Viable

2.1 Coating of Electrodes

Stanford researcher Hongjie Dai and his team aimed to find a technique to keep ocean water from corroding the submerged anodes due to its high salt content. They discovered coating the anode with rich layers of negative charges reduces the breakdown of the underlying metal. They employed iron, nickel hydroxide, and nickel sulfide to create a negatively charged coating that protects the anode during electrolysis. As a result, they could generate ten times more electricity through the multilayer device, accelerating hydrogen production from salt water.

2.2 Salt Water Electrolysis with a Semi-permeable Membrane

Researchers led by Evan Pugh and Bruce Logan have succeeded in splitting seawater to produce green hydrogen. The pre-desalination procedure in this process is costly. However, the team has reduced the cost by employing a thin semi-permeable membrane to filter water in the reverse osmosis treatment. The reverse osmosis membrane replaced the typical ion exchange membrane seen in electrolyzers. Reverse osmosis works by applying a lot of pressure to the water and forcing it through the membrane while leaving the chloride ions behind.

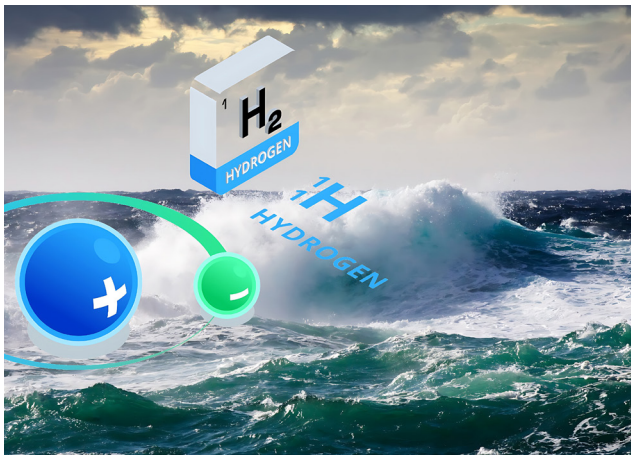
2.3 Platinum Catalyst to prevent Recombination of Ions

A novel catalyst has been created by scientists from Shaanxi Normal University and Swinburne University's Centre for Translational Atomaterials that can synthesize green hydrogen from seawater via solar energy. The researchers designed the Ocean-H2-Rig prototype to use this new catalyst. It can manufacture green hydrogen from salt water floating on the water's surface.

In typical photocatalysts, water splits into hydrogen and oxygen when electrons and holes are separated in response to solar light. The separated electrons and holes tend to unite again, drastically lowering the photocatalytic activity and the efficiency of hydrogen synthesis. The photo-generated electrons are successfully extracted by the single-atom platinum catalyst created in this work, preventing undesired recombination. It significantly boosts the effectiveness of hydrogen production. The reusable catalyst is among the most efficient ever reported since it promotes highly efficient hydrogen generation with an exceptional quantum yield of 22.2% under LED-550 illumination.

2.4 Salt Water Electrolysis via Forward Osmosis

Harvard researchers successfully used forward osmosis to separate salt water into clean hydrogen and oxygen gas. They created hydrogen gas by forward-osmosis and electrochemical water splitting, which is useful for storing renewable energy. The researchers enhanced the natural mechanism of osmosis to collect clean water from natural sources such as the ocean. There is no requirement for a separate water purifying system because this technology enables salt water use.



3. The Benefits of Seawater Conversion for Green Hydrogen

- The use of seawater for hydrogen production presents several advantages over conventional methods. Firstly, seawater is an almost limitless resource, providing an inexhaustible supply for green hydrogen production. This is particularly beneficial in regions with abundant coastlines and ample sunlight, where the combination of renewable energy and seawater conversion could drive the establishment of a thriving green hydrogen industry.

- Seawater conversion offers a more cost-effective and energy-efficient alternative to desalination, which is typically required for conventional electrolyzers. Desalination processes can significantly increase the operational and maintenance costs of hydrogen production, making it less economically viable.

By bypassing desalination and directly utilizing seawater, the cost of green hydrogenproduction can be significantly reduced, making it more competitive with fossil fuel-sourced hydrogen.

- Seawater conversion eliminates the production of chlorine gas, which is a byproduct of electrolysis when using saltwater. Chlorine gas can be highly corrosive and detrimental to the longevity and efficiency of electrolyzers. By preventing the formation of chlorine gas, researchers have achieved successful and prolonged operation of electrolyzers, ensuring the stability and reliability of green hydrogen production from seawater.

4. Addressing Freshwater Scarcity Concerns

While the use of seawater for green hydrogen production offers numerous benefits, concerns have been raised regarding the potential impact on freshwater supplies. The production of green hydrogen at a large scale using seawater electrolysis could require significant amounts of freshwater, potentially exacerbating existing water scarcity issues.

To address this concern, researchers have proposed alternative methods that minimize the consumption of freshwater while still utilizing seawater as the electrolyte. One such approach involves the use of membranes that allow only freshwater vapor to pass through from the surrounding seawater bath. This internal distillation process replenishes the freshwater supply within the electrolyzer, limiting the need for additional freshwater resources.

Furthermore, integrating green hydrogen projects with existing desalination plants could provide a sustainable solution. Commercial desalination plants already possess efficient membrane systems capable of producing freshwater while adding minimal costs to green hydrogen production. By leveraging the infrastructure and expertise of desalination plants, the integration of green hydrogen production could be streamlined and economically viable.

5. The Path to Commercialization

The use of seawater directly for green hydrogen production can significantly reduce the strain on freshwater resources. In water-scarce areas, the ability to tap into seawater as a natural feed for electrolysis offers a sustainable solution. By eliminating the need for desalination or other pre-treatment systems, the technology can reduce costs and minimize environmental impact.

5.1 Platinum Catalyst to prevent Recombination of Ions

Countries like India, which have set ambitious targets for green hydrogen production, can benefit greatly from seawater electrolysis. India's National Green Hydrogen Mission aims to produce at least five million metric tonnes of green hydrogen per year by 2030. By utilizing seawater directly for electrolysis, India can avoid putting additional pressure on freshwater resources and maximize the use of industrial and municipal wastewater for hydrogen production.

5.2 Integration with Desalination Plants

Some experts argue that integrating green hydrogen production with desalination plants could offer a practical solution to the freshwater challenge. Desalination plants already have efficient mechanisms for extracting freshwater from seawater and could provide a cost-effective way to obtain purified water for electrolysis. By leveraging the existing infrastructure and expertise of desalination plants, the water requirements for green hydrogen production could be met without further straining freshwater resources. This integration could significantly reduce the cost and environmental impact of green hydrogen production.

5.3 Overcoming Technological Challenges

The research on seawater electrolysis is still in its early stages, and the technology readiness level (TRL) is relatively low. However, researchers are optimistic about the future commercialization of seawater electrolysis.

Collaborations with industry partners and further optimization of the technology are essential steps towards achieving TRL 7 or 8, where commercialization becomes feasible.

6. Ohuim and Aquastill's offer Low-cost Co-benefits

Ohmium, a California-based company that develops green hydrogen electrolyzers, has found a partner in Aquastill, a provider of desalinated water systems. The two will work together to produce green hydrogen fuel from desalinated ocean water. Aquastill's desalination device uses waste heat as an input, and will make use of residual heat from Ohmium's electrolysis process. This offers co-benefits in cooling Ohmium's system while powering desalination.

The two companies are currently developing how to optimize integration of the systems, which are highly modular and can be scaled from megawatt to gigawatt scale. Offshore wind energy was identified as a potential electricity source for the modular system, and solar is often a great match due to its high modularity and ability to be installed on bodies of water. Ohmium's second generation proton exchange membrane electrolyzer produces at a rate of 9.0 kg per hour with a four-second ramp-up time. It is compatible with three-phase with 480 VAC/60Hz, 415 VAC/50Hz, or 400VAC/50Hz with optional DC integration.

The US Department of Energy (DoE) is targeting lower green hydrogen costs. Launched in 2021, the Hydrogen Shot program has a "1-1-1" goal, targeting costs of $1 per 1 kilogram in 1 decade. In 2022 renewable energy-fueled hydrogen cost roughly $5 per kilogram, so this target represents a cost reduction of 80% in one decade.

The DoE's investments in green hydrogen are on the rise. In 2021, it supported $285 million in funding, and in 2022, the President's Fiscal Year 2022 Budget Request included the application for $400 million in funds for green hydrogen development.

Siemens drives Sustainability with Digitalization

Digital sustainability is an approach that harnesses one of the most powerful forces for societal change, namely digitalisation, to deliver what we need and want in a sustainable way. Further, it represents a 21st-century tool for discussing, reflecting on and assessing our real individual and societal needs and wants. For a long time, there was a real tension between the satisfaction of our basic needs and the potential destruction of the planet. There were no known ways to provide enough nutrition, basic mobility and buildings for universal sustenance, shelter and survival, without destroying the planet in the process. With digitalisation, it is now possible to provide for our basic needs in a sustainable way, while also providing transparency so that we can see the consequences of our actions.

1. Digitalisation and Decarbonisation

Digital connectivity serves as the foundation for achieving sustainability across multiple facets. It enables the decarbonization of the supply chain and enhances efficiency, cutting emissions, and improving throughput. Siemens recognizes the transformative power of digitalization and has developed the Xcelerator program to support companies in their journey towards a sustainable future. Digitalisation helps to integrate renewable energy sources into the grid by managing power flows, balancing supply and demand, and optimising energy storage, for example, digital control systems such as Omnivise T3000 can help manage the intermittency of solar and wind power by predicting energy output and adjusting supply accordingly. Integrated data management is a solution that supports decarbonisation.

> *"Siemens Energy VP (Rossetti) says "Integrating operations and engineering data can enable engineers to do their jobs more efficiently. Overall, digitalisation can enable the optimisation of energy and resource use, reduce fuel consumption, and promote sustainable practices, contributing to decarbonisation efforts"*

2. Digitalisation boosting Efficiency in Power Generation

The digital design is fundamental to improve efficiency and energy generation. Siemens Energy offers solutions from their Omnivise portfolio, including the Omnivise Asset Management (OAM) software, which can optimize energy plants. An example of these capabilities can be seen in the operations of one of Latin America's largest electricity suppliers, which manages a vast fleet of diverse power generation assets – ranging from fossil to renewable sources.

The company, in a bid to trim Operational Expenditures (OPEX) across its maintenance and operations, wanted to introduce a remote expert centre at its headquarters.

> *"The OAM software forms the central technical backbone to deliver critical services to their entire fleet of assets," Rossetti says. "Our solution will enable the customer to reduce operational costs while increasing reliability and availability of key assets at 23 power plants"*

With OAM, Siemens Energy also supports broader use cases from remote operator rounds and inspections all the way to autonomous plants. The plant's automatic vision is based on real data, with advanced technology that uses digital technology, data analysis and AI que of old devices and intelligent devices. The artificial intelligence irregularities cause sensors and cameras to move, asking for what they need. It also permits the personal care and other control facilities to replace small plants. In resumption, the digitalización and the energy generation are transforming the operating efficiency and all the camino plants that are more automated and efficient.

3. Digital Control Systems helping Manage New Challenges in the Energy Industry

The energy landscape is changing and the number of renewable energy sources is growing steadily. With that comes pressure on fossil-fueled power plants to operate more flexibly and efficiently. Digital control systems such as Omnivise T3000 from Siemens Energy can help to manage these new challenges. This system with its SCADA functionality is capable of managing a variety of different decentralised energy resources including wind offshore, automated, autonomously and in a coordinated way, ensuring reliable 24/7 operation. At the same time, it is flexible and scalable to support a larger number of assets when needed.

> *"Omnivise T3000 is the perfect solution not only for fossil power generation and renewables, but also for large and mid-size microgrids, such as IPPs, islands, industries, data centres and mines, says Rossetti"*

Together with German utility MVV, Siemens Energy has built and recently put into operation a large-scale heat pump plant at the GKM power plant in the city of Mannheim. The plant uses river water as a heat source, helping to replace a coal-fired power plant. This new heat pump will be a major contributor to MVV and the City of Mannheim's goals to become CO2 neutral in heating production by 2030.

The facility is expected to supply district heating for 3,500 households and save some 10,000 tonnes of carbon emissions per year.

Omnivise T3000 control system integrates the control of the new heat pump and an existing thermal storage into the existing GKM power plant. The control system uses its multi-unit functionality to manage multiple generation units from a central control room.

> *"Digitalisation with Omnivise can enable the optimisation of energy and resource use, reduce fuel consumption, and promote sustainable practices, contributing to decarbonisation efforts"*

4. Engaging Stakeholders through Digital Channels

In addition to leveraging data analytics and AI, Siemens Energy recognizes the importance of engaging with stakeholders on sustainability issues. Digital channels, such as social media platforms, provide a powerful means of communication and enable companies to connect with customers, suppliers, and other key stakeholders. Siemens Energy encourages businesses to use social media platforms to raise awareness of climate change and sustainability initiatives. By sharing information and engaging in conversations, companies can educate their audience and inspire action. Social media campaigns, such as Unilever's Small Big Change and IKEA's 'The Better life at home challenge,' have successfully reached millions of people and encouraged them to adopt more sustainable practices. These initiatives not only raise awareness but also foster a sense of community and collective responsibility.

Digital channels also provide an opportunity for businesses to communicate their sustainability commitments and progress. By sharing updates, milestones, and success stories, companies can build trust and confidence in their ability to deliver on sustainability goals. Social media platforms allow for two-way communication, enabling companies to listen to feedback, address concerns, and collaborate with stakeholders to drive meaningful change.

5. Security and Privacy in the Digital Era

As digitalization becomes more pervasive, ensuring the security and privacy of data has become a critical concern. Siemens Energy understands the importance of protecting control systems and customer data from cyber threats. The company has invested in comprehensive cybersecurity measures and offers solutions to help businesses safeguard their infrastructure.

Siemens Energy's Omnivise T3000 control system, for example, incorporates built-in security features and is designed to provide long-term support. The system is constantly updated with security patches, ensuring that it remains secure and up-to-date. Additionally, Siemens Energy has established a Cyber Security Operation Center (cSOC) to help organizations defend against cyberattacks. The cSOC provides round-the-clock monitoring and support, ensuring that businesses can effectively respond to emerging threats. By prioritizing cybersecurity and offering robust solutions, Siemens Energy enables businesses to embrace digitalization without compromising security or privacy. This allows companies to leverage the full potential of digital technologies while maintaining trust and confidence in their operations.

6. Accelerate Transformation through an Ecosystem-based Model

To accelerate transformation through an ecosystem-based model, organizations can collaborate with strategic partners to merge technology and share expertise. This collaboration enables companies to pursue growth, develop new business models, and address critical challenges such as emissions reduction, waste minimization, and resource optimization.

By working together in broader ecosystems, organizations can leverage the experience and resources of various participants, leading to sustainable growth and benefits for multiple stakeholders. For instance, the partnership between Siemens and Mercedes in digital manufacturing and efficient automation in car production is driving towards more sustainable and energy-efficient production methods. The number of these more extensive ecosystems is growing.

In northern Germany, Siemens is involved in a project to develop energy-distribution grids optimized for renewable-energy sources and connections. It spans 21 different ecosystem participants, offering expertise in areas such as grid management, rural and urban planning, and components manufacturing, and also involves two non-governmental organizations. Some partnerships will be more about socially conscious collaboration than commercial endeavor. Groups such as Corporate Eco Forum and The Climate Pledge bring together like-minded public and private organizations to forge new business strategies for sustainability.

Organizations such as the Science Based Targets initiative (SBTi) and the World Economic Forum provide further support. Data exchange is another area where ecosystems can create value.

In automotive, for example, the Catena-X network is building a continuous data exchange for contributors from across the industry's value chain. The aim is to develop an operating system with standardized protocols that govern end-to-end data chains and create collective intelligence banks to serve several use cases, including securing data sovereignty and interoperability. These partnerships can span across sectors and focus on both commercial and socially conscious endeavors.

7. Current Global Goals and New Opportunities

It's important to define specific goals for companies embracing a net-positive approach within a broader vision of a sustainable future. Vision 2050, as proposed by WBCSD, envisions a world where around 9 billion people live well within the planet's limits, emphasizing equity, essential services like food and mobility, and respect for environmental boundaries. To operationalize this vision, the text suggests starting with the Sustainable Development Goals (SDGs), a set of 17 global objectives agreed upon by world leaders to be achieved by 2030. While the SDGs cover critical global challenges, they may not be directly tailored for corporate use. To address this gap, cross-referencing the SDGs with scientifically prioritized challenges, such as global causes of death and risks to civilization, could help companies focus on key sustainability issues. By aligning efforts with priorities like resource conservation, education, and health improvements, companies can contribute positively to a sustainable future while leveraging opportunities for impactful change.

8. Embracing a Sustainable Future

Siemens' commitment to sustainability extends beyond individual initiatives. The company emphasizes the importance of powering rail systems with green electricity or hydrogen to maximize sustainability. Through offerings like the Mireo Plus H and Mireo Plus B trains, as well as Vectron Dual Mode locomotives, Siemens ensures that its solutions align with sustainability goals.

Siemens Xcelerator, an open digital platform, serves as a holistic solution to enable sustainable transformations across industries. By scaling up smart infrastructures and automation solutions, businesses can accelerate their digital transformation journey. The platform offers a range of IoT-enabled hardware, software, and digital services, empowering organizations to make informed decisions and optimize their operations.

9. Conclusion

Digital sustainability harnesses digitalization to meet needs sustainably, addressing the tension between basic needs and environmental impact. Siemens' Xcelerator program exemplifies how digitalization aids decarbonization by integrating renewable energy sources efficiently. For instance, Omnivise T3000 manages energy flow, enhancing sustainability efforts in power generation. Digital control systems support flexible operations in the evolving energy landscape.

Engaging stakeholders through digital channels is crucial for fostering sustainability awareness. Companies like Siemens Energy use social media to communicate sustainability commitments, encouraging sustainable practices. Security is vital, with Siemens Energy investing in cybersecurity to protect data and control systems from cyber threats. Ecosystem-based collaboration accelerates transformation towards sustainability. Partnerships like Siemens and Mercedes in digital manufacturing drive energy-efficient production methods. Siemens' involvement in projects like optimized energy grids demonstrates collaborative efforts for sustainable growth.

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Pumped Hydro: Australia's Renewable Energy Storage Solution

Energy storage is an increasingly important part of electricity system as it allows us to ensure energy is always available. Pumped hydro is the most common and most mature form of this energy storage. In Australia's quest for a sustainable energy future, pumped hydro energy storage (PHES) has emerged as a vital component of the renewable energy storage solution. As the country transitions away from coal and embraces wind and solar power, the need for efficient and reliable energy storage becomes increasingly apparent.

1.How Pumped Hydro works?

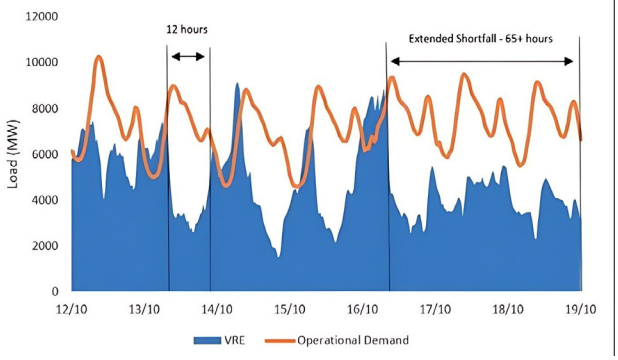
Pumped hydroelectricity schemes are a flexible way of managing our demand for electricity. In conventional hydroelectricity generation, water flows from a dam or reservoir where it has been stored and is then channelled through rotating turbines. These turbines then generate power. Pumped hydro operates on the same principle except that two dams, one higher than the other, work in a cycle that pumps water into the upper reservoir during off-peak hours. Potential energy is then stored and generated when it's needed.

For example, when prices are cheap but demand is low, water in the low reservoir is pumped to the higher reservoir until it is needed for generation. When both prices and demand are high, the water is released back into the lower reservoir-gravity does much of the work, so this energy production is cheap and efficient.

2. Why Pumped Hydro?

The bulk of Australia's population lives at the latitude of regular weather fronts, resulting in a pattern of a few days of sunshine, then wind, sunshine, then clouds. This translates into days of good renewable output, and inevitably some with a lot less. This output is seasonal too: far less solar e energy is produced in winter than in summer. As the proportion of renewable energy in the grid increases, these gaps in energy generation are going to be increasingly problematic, with massive amounts of storage needed to fill them (See figure 1).

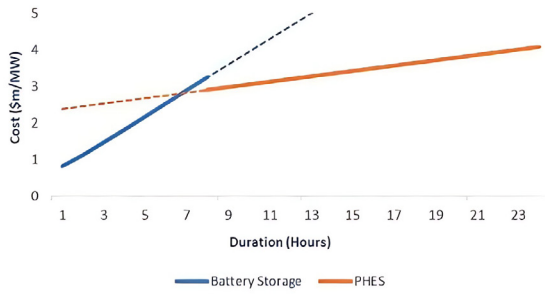
Figure 1 Projected demand and renewable production in 2030 (based on scaled real data 12/10/23–19/10/23)



To match our future energy needs, we're going to need storage that covers various timescales, from whole seasons, to the time between weather fronts (a few days), to diurnal and shorter.

This is where PHES comes in. Pumped hydro is really good at covering those longer timescales, and much more cost effective than other forms (See figure 2).

Figure 2 Coast of Energy Storage vs Duration in 2030



It's short-sighted to think that battery storage will be able to cover every timescale from the sub-second to the seasonal-it's too expensive, with high environmental costs. Pumped hydro projects also have a much longer lifespan than batteries-more than 50 years versus around 20- and lower maintenance requirements, offering along-term, sustainable solution.

Pumped hydro has an important role to play in filling the long-duration roles currently masked by coal. The key reason that PHES is essential for our future grid is that it can generate long after other storage technologies have been depleted. It can charge for many hours-for example, over the whole weekend when prices are low-and discharge over days during the next lull in renewable-energy generation between weather fronts. This allows it to fill the role currently played by coal, cost effectively (per MWh) and sustainably, with reliable, tried- and-tested technology. To give some idea of the scale of our future energy storage needs, by 2050 we will need to increase our long-term storage from 1.5GW (in 2022) to 16GW; that's 170GWh of medium-deep storage according to the ISP 2022 Step Change Scenario (excluding Snowy 2.0). Without pumped hydro, this would require 13.5 million Tesla Powerwalls-that's more Powerwalls than there are houses in Australia.

3. Environmental Considerations and Sustainable Solutions

The environmental impact of energy projects is of utmost importance in today's context. Pumped storage hydropower offers several sustainability advantages. Existing closed-loop pumped storage projects, like the one proposed in Marmora, minimize environmental impacts by not being connected to existing river systems. They can be located where needed to support the grid, without disrupting aquatic ecosystems. Furthermore, the long asset life, low maintenance requirements, and independence from raw materials make pumped storage a cost-effective and sustainable energy storage solution. The durability and reliability of the technology ensure long-term benefits for grid stability and energy system resilience.

This massive building, which is located in the center of the city, uses photovoltaic panels that are integrated into its transparent facade to harness solar power.
In addition to producing clean energy, the Solar Dome offers shade and a cozy atmosphere for both locals and guests, demonstrating Neom's dedication to fusing sustainability and human-centered design.

4. Successful Pumped Storage Models Around the Globe

According to the International Hydropower Association (IHA), total installed pumped hydro capacity was estimated at approximately 158 GW in 2019 and can store globally up to 9,000 GWh. Several studies have identified vast potential for the development of pumped storage sites worldwide, and there is also a strong potential for retrofitting disused mines, underground caverns, non-powered dams and conventional hydro plants. With more than 100 projects in the pipeline, IHA estimates that pumped hydropower storage capacity is expected to increase by almost 50% – to about 240 GW by 2030.

In terms of energy storage capacity, IRENA estimates that pumped hydro storage capacity will increase by 1,560-2,340 GWh above 2017 levels by 2030. In the longer term, IRENA forecasts that pumped hydro would need to double, reaching 325 GW by 2050 to accompany the global energy transition. Recent developments globally were mainly driven by China. Approximately 80% of new pumped hydro plants currently under construction are located in China. Other projects have recently been commissioned or are still under construction in Europe, Asia, Israel, Australia, Morocco, or United Arab Emirates.

4.1 Pumped Hydro Projects in Australia

Australia is already making significant strides in pumped hydro energy storage. The Kidston Pumped Storage Hydro Project, located in Queensland, is one such notable undertaking. With a capacity of 250MW, it will provide a reliable source of dispatchable energy for the region. The project utilizes the existing Kidston Gold Mine infrastructure, repurposing the abandoned open pit as the upper reservoir and constructing a lower reservoir to complete the system.

Another promising project is the Snowy 2.0 expansion in New South Wales. The ambitious undertaking aims to increase the Snowy Hydro Scheme's capacity by adding 2,000MW of pumped hydro storage. By utilizing the existing Snowy Mountains hydroelectric scheme, this expansion will enhance the system's ability to store and dispatch renewable energy, further supporting Australia's transition to a clean energy future.

4.2 China: Managing Pumped Storage as a Grid Asset

China is heavily investing in clean energy solutions to meet rising energy demands and transition to renewables. In the 13th Five Year Plan, they aimed to increase pumped hydro storage capacity to 40 GW by 2020 and target 90 GW by 2025. These facilities support wind, solar, coal, and nuclear power sources, providing power during peak demand and acting as emergency standby.

Managed by state-owned grid companies, storage assets are considered grid assets. A two-part tariff scheme, comprising capacity payments and energy tariffs, ensures project viability by rewarding availability and compensating for operating costs, optimizing resource utilization.

4.3 India: Firming Renewables through Combined Auctions

India has set up very ambitious renewable energy targets, as the country aims to reach 175GW of installed renewables by 2022, meaning it has to connect 30 to 40 GW of renewable capacity annually. It is also targeting to reach 450 GW of renewables installed base by 2030, including Hydropower. This additional capacity will have to be balanced with flexible storage power assets.

Pumped Storage can play a critical role to enable a smooth energy transition through the provision of flexible peak power capacity. India currently has 2.6 GW of Pumped Storage that are already operational and another 3.1 GW under construction. Additionally, about 90 GW of Pumped Storage potential has been identified across 63 sites and recognized in national energy policies for their valuable grid services.

4.4 Middle East and North Africa: Securing a Cleaner Energy Mix

Several countries in the Middle East and North Africa have started the decarbonization of their power fleet. They are leveraging the solar resources which offer great potential in the region as well as wind power in some cases. Besides, several countries such as the United Arab Emirates, Egypt or Turkey also plan to install their first nuclear power plants. Both the integration of higher shares of renewable energy together with the development of nuclear power capacity has led those countries to develop pumped hydro plants. Thus, in UAE, the Dubai Energy and Water Authority (DEWA) has launched the construction of a 250 MW pumped hydro storage plant.

5. The Future of Pumped Storage Hydropower

The future of pumped storage hydropower is promising, with continued advancements in technology and increased investments in projects around the world. As the demand for large-scale energy storage solutions grows, PSH will play a vital role in balancing the grid, supporting the integration of renewable energy, and ensuring a reliable and sustainable energy supply.

The ongoing research and development in pumped storage technology are focused on further improving efficiency, flexibility, and performance. Variable speed solutions, such as those implemented by Hitachi Energy, offer even greater control and responsiveness to grid conditions, maximizing the benefits of pumped storage systems. As renewable energy sources continue to expand, PSH will provide the necessary stability and grid support services to accommodate their variability.

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Emerson releases a Smart Application for Valve Maintenance

The Emerson app for optimizing valve maintenance is a cutting-edge solution designed to streamline and enhance the maintenance process for industrial valves. In today's fast-paced industrial landscape, the efficient operation of valves is crucial for ensuring optimal performance and minimizing downtime. The Emerson app offers a comprehensive suite of tools and features that empower maintenance teams to proactively monitor, troubleshoot, and maintain valves with precision and ease. By leveraging the latest in digital technology, this app revolutionizes valve maintenance practices, leading to improved reliability, increased efficiency, and cost savings for industrial facilities.

1. Emerson App: A Smart and Efficient Way to Monitor and Maintain Your Valves

Emerson has recently introduced the Plantweb Insight Valve Health Application, a software tool that merges Fisher's control valve knowledge with advanced analytical algorithms. This fresh application enables users to visualize an entire connected fleet of valves, with a focus on prioritizing actions based on the health index of each valve. By doing so, plant staff can enhance valve repair processes, leading to quicker and more effective maintenance decisions that ultimately reduce downtime. Most process plants and facilities house numerous control valves across various applications.

These valves consist of multiple components that need to work together seamlessly to regulate process media flows, with certain parts constantly in direct contact with the media.

Typically, this monitoring is carried out individually for each valve, either locally or remotely, which is a time-consuming task requiring a high level of expertise to assess valve health and determine necessary actions.

2. How Emerson's Software tool helps Plant Personnel maintain their Control Efficiently?

Control valves are essential components of many industrial processes, as they regulate the flow of fluids such as liquids, gases, and steam. However, control valves are also subject to wear and tear, and may deteriorate over time due to harsh operating conditions, corrosion, erosion, or fouling. This can affect the performance and reliability of the valves, and lead to process inefficiencies, safety hazards, or unplanned shutdowns. Therefore, it is important for plant personnel to monitor and maintain their control valves regularly and effectively.

Emerson, an industry leader in automation and digital transformation on a worldwide scale, has created a potent software solution that makes it easier for plant staff to monitor and manage its control valves. The application, known as Plantweb Insight Valve Health Application, evaluates each valve's status and delivers timely and useful information using sophisticated analytic algorithms. With the app, users can prioritize maintenance and repair tasks based on many indicators, see the complete linked fleet of valves, and cut down on analysis, troubleshooting, and downtime.

The app generates alerts and recommendations for maintenance actions, prioritized by urgency and financial impact. The app includes explanations, suggestions, and estimated time to take action.

This helps plant personnel to focus on the most pressing problems, and to plan and schedule maintenance activities accordingly.

3. The New OMNIMATE 4.0 Terminal Blocks Features

PCB Connectors is Printed Circuit Board, which is a thin board made of fiberglass, composite epoxy, or other laminate material that contains conductive pathways for connecting electronic components. PCBs are used in many electronic devices, such as computers, phones, TVs, and radios.

The company's range of PCB products includes OMNIMATE 4.0 Terminal Blocks with Weidmuller's SNAP IN technology, offering efficient wiring and signal transmission across various industrial sectors.

This innovative technology enables quick connection of a diverse range of conductors without requiring tools or wire-end ferrules, making OMNIMATE suitable for a wide range of automated processes.

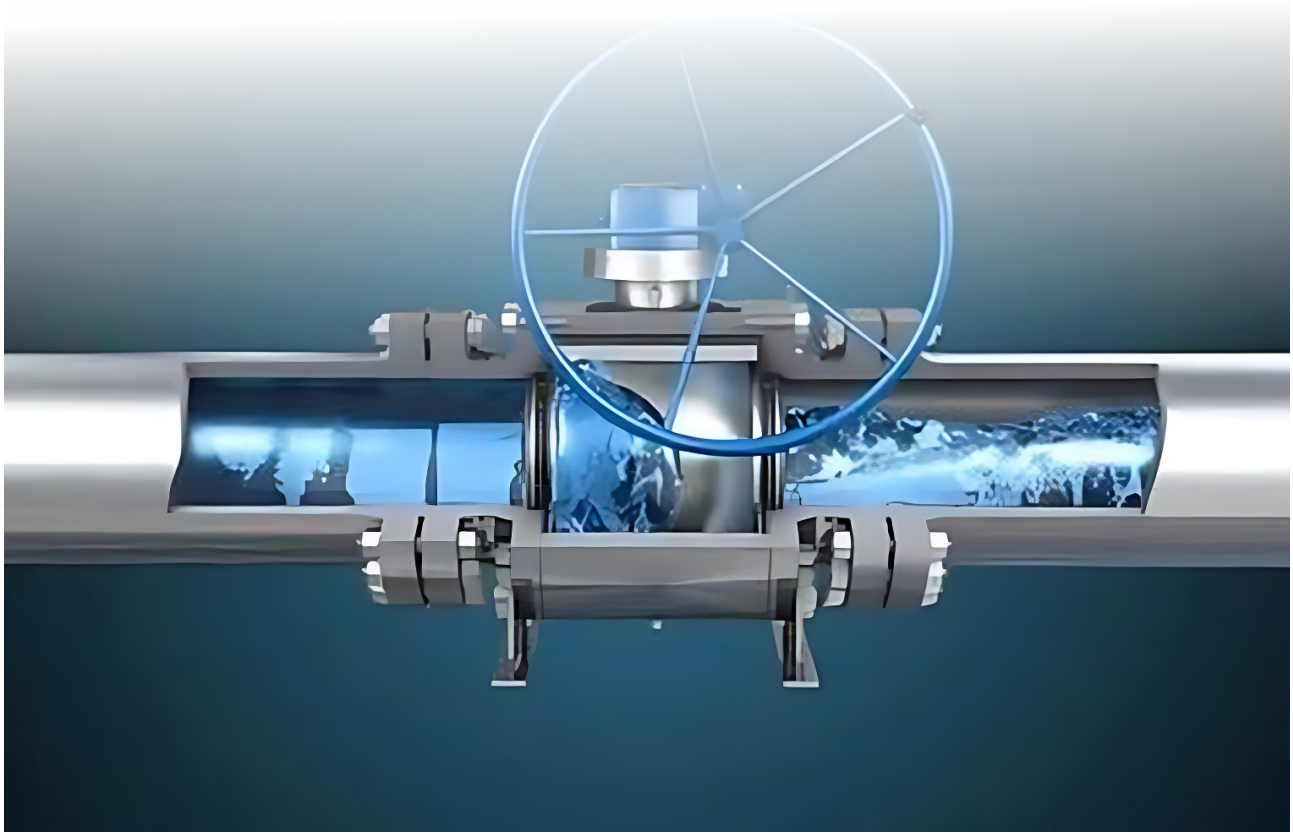
The features include:

- Pitch: 5.00 mm; orientations: vertical and horizontal; positions: 2–12. When the wiring is finished, an optical and auditory safety indicator is displayed.
- Push-in buttons are simple to work with when rewiring is required.
- All components are delivered with an open clamping point and are wire-ready.
- Screw, Push-In, and Snap-In connectivity options provide customers more options to choose the connection technique that best suits their needs.
- Optimization for completely automated wiring operations that is ready for robot use.

4. Emerson App reduces Valve Failures, Unplanned Shutdowns, and Maintenance

Valve failures are one of the major causes of unplanned shutdowns in industrial plants, as they can compromise the safety and efficiency of the processes. Valve failures can also result in high maintenance costs, as they require frequent inspections, repairs, and replacements. Therefore, it is important for plant personnel to prevent or minimize valve failures by performing timely and effective maintenance activities.

Based on variables such as valve position, travel, friction, leakage, and performance, the Valve Health Index is a numerical number that represents each valve's state of health. To further enhance the index's informativeness, users can add details about their plant's operations, such as the criticality of a valve and the financial consequences of a failure. The programme then offers notifications and suggestions for maintenance tasks, ranked by urgency and financial effect, along with real-time and actionable data on each valve's performance and condition. Using this application, plant staff can prioritize issues and plan and schedule maintenance tasks appropriately. The Plantweb Insight Valve Health Application has been proven to reduce valve failures, unplanned shutdowns, and maintenance costs in various projects around the world.



5. The Newest Projects that use Emerson App to optimize Valve Maintenance

5.1 Valve Health Monitoring System (VHMS)

One of the newest projects that use Emerson app to optimize valve maintenance is the Valve Health Monitoring System (VHMS), implemented by Saudi Aramco at its Shaybah Gas Oil Separation Plant (GOSP-1). The project aims to improve the reliability and performance of the plant's critical control valves, which are exposed to harsh operating conditions and frequent sandstorms. The project involves installing Emerson's WirelessHARTtransmitters on 290 control valves, and integrating them with the Plantweb Insight Valve Health Application. The app analyzes the data collected by the transmitters and provides real-time insights on the condition and performance of each valve. The app also generates alerts and recommendations for maintenance actions, prioritized by urgency and financial impact. The project is expected to reduce valve failures, unplanned shutdowns, and maintenance costs, as well as increase safety and productivity. According to Saudi Aramco, the project has achieved a 99.5% valve availability rate, and a 50% reduction in valve-related trips. The project has also won the 2023 MEED Projects Award for the best oil and gas project in the GCC region.

5.2 Valve Performance Monitoring System (VPMS)

The Valve Performance Monitoring System (VPMS), implemented by Shell at its Prelude Floating Liquefied Natural Gas (FLNG) facility. The project aims to enhance the reliability and availability of the facility's critical valves, which are essential for the safe and efficient operation of the world's largest floating structure.

6. Overcoming the Obstacles for Blockchain

The project involves installing Emerson's Rosemount™ Wireless Acoustic Transmitters on 179 valves, and integrating them with the Plantweb Insight Valve Health Application. The app analyzes the acoustic data collected by the transmitters and provides real-time insights on the condition and performance of each valve. The app also generates alerts and recommendations for maintenance actions, prioritized by urgency and financial impact. The project is expected to reduce valve failures, unplanned shutdowns, and maintenance costs, as well as increase safety and productivity. According to Shell, the project has achieved a 98% valve availability rate, and a 40% reduction in valve-related trips. The project has also won the 2024 Offshore Technology Conference Spotlight on New Technology Award for the best offshore project in the world.

7. Emerson App : Future Prospects and Enhancements.

Emerson's latest app has been making waves in the industry, offering cutting-edge solutions for improved efficiency and maintenance processes. Looking ahead, the future prospects for Emerson's app appear promising, with potential enhancements focusing on advanced analytics, predictive maintenance capabilities, and enhanced user interfaces. The Future enhancements must include the following:

- Leveraging 5G technology to improve speed and efficiency of data transmission and communication.
- Integrating OpenAI technologies to create more personalized and intelligent features, such as content generation, image recognition, and predictive analytics.
- Incorporating environmental sustainability and net-zero emissions goals into the app design and functionality.

Navigating Risk in the Renewable Energy Sector: Strategies for Success

The renewable energy sector has witnessed significant growth in recent years, driven by the increasing demand for clean and sustainable energy sources. As countries around the world strive to reduce their carbon footprint and combat climate change, the development and deployment of renewable energy projects have become a key focus. However, navigating the renewable energy sector comes with its own set of challenges and risks that need to be carefully managed.

1. Understanding the Risks in the Renewable Energy Sector

Before delving into risk management strategies, it is essential to have a comprehensive understanding of the risks associated with the renewable energy sector.

1.1 Geopolitical Risks

Energy companies are subject to geopolitical risks arising from political instability, trade disputes, and international conflicts. Government policies and regulations can significantly impact the profitability and viability of renewable energy projects. Changes in incentives, subsidies, or feed-in tariffs can disrupt project economics and affect the long-term financial performance.

1.2 Technological Risks

Technological risks also play a significant role in the renewable energy sector. The rapid advancements in renewable energy technologies bring both opportunities and challenges.

The reliability and performance of renewable energy systems, such as solar panels and wind turbines, need to be carefully monitored and managed to ensure optimal energy generation. Additionally, the integration of renewable energy into existing grids and infrastructure can pose technical challenges that need to be addressed.

1.3 Financial Risks

Financial risks pose another challenge in the renewable energy sector. The high upfront capital costs and long payback periods make financing renewable energy projects a complex endeavor. Fluctuations in interest rates, currency exchange rates, and the availability of financing options can impact the financial viability of projects. It is crucial for project developers and investors to carefully assess and mitigate these risks to ensure project success.

2. Risk Management Strategies for Renewable Energy Projects

To navigate the risks in the renewable energy sector, it is essential to employ effective risk management strategies. One of the key strategies is to conduct thorough due diligence before investing in or developing a renewable energy project. This involves evaluating the political and regulatory landscape, understanding the financial risks, and assessing the technological feasibility of the project.

2.1 Assessing Political and Regulatory Risks

Assessing political and regulatory risks is crucial in the renewable energy sector. This involves staying updated with government policies and regulations, and analyzing their potential impact on project economics. Engaging with policymakers and industry associations can provide valuable insights into the future direction of renewable energy policies. By actively monitoring and assessing political and regulatory risks, project stakeholders can adapt their strategies and mitigate potential disruptions. For example, the London Array offshore wind farm, located in the Thames Estuary in the United Kingdom. This project faced significant political and regulatory risks during its development phase. However, by actively engaging with policymakers and local communities, the project developers successfully navigated these risks and obtained the necessary permits and approvals. The London Array project serves as an example of how proactive stakeholder engagement and effective risk mitigation strategies can lead to project success.

2.2 Mitigating Financial Risks

Mitigating financial risks is another critical aspect of risk management in the renewable energy sector. This can be achieved by diversifying sources of financing, utilizing hedging instruments to mitigate currency risks, and carefully evaluating the financial performance of projects. Conducting thorough financial feasibility studies and stress tests can help identify potential risks and assess the project's ability to withstand adverse market conditions. It is also essential to establish robust financial risk management processes and regularly monitor the financial performance of projects.

2.3 Mitigating Technological Risks

Managing technological risks is equally important in the renewable energy sector. This involves implementing proper monitoring and maintenance protocols to ensure the reliable performance of renewable energy systems. Regular inspections, predictive maintenance, and data-driven analytics can help identify potential issues before they escalate into significant problems.

Collaboration with technology suppliers and industry experts can provide valuable insights into the latest advancements and best practices in renewable energy technology.

For example, the Hornsdale Power Reserve project in South Australia. This project, developed by Tesla, is the world's largest lithium-ion battery energy storage facility. The project successfully managed technological risks by implementing advanced battery monitoring systems and predictive maintenance protocols. This ensured the reliable performance of the energy storage system and minimized downtime.

3. The Role of Insurance in Risk Management for Renewable Energy

Insurance plays a crucial role in risk management for renewable energy projects. Renewable energy projects involve substantial investments, and insurance can provide protection against unforeseen events that could result in financial losses. Project developers and investors can obtain various types of insurance coverage, such as property insurance, liability insurance, and business interruption insurance. These insurance policies can cover risks related to equipment damage, natural disasters, third-party claims, and revenue losses due to project downtime.

Insurance companies specializing in renewable energy can offer tailored insurance products that address the specific risks faced by renewable energy projects. These products often include coverage for project construction, operation, and maintenance phases. Insurance companies also provide risk engineering services, which involve conducting risk assessments, monitoring project performance, and providing recommendations to mitigate potential risks. Engaging with experienced insurance providers can provide valuable risk management support throughout the project lifecycle.

4. Opportunities and Future Trends in the Renewable Energy Sector

Despite the risks involved, the renewable energy sector presents numerous opportunities for growth and innovation. The increasing adoption of renewable energy technologies, such as solar and wind power, opens up new markets and investment opportunities. The declining cost of renewable energy such as wind and solar power over time (In 2014, the levelized cost of offshore wind was around $200 per MWh, and by 2023, it had fallen to $127, excluding subsidies), coupled with advancements in energy storage technologies, are driving the transition towards a clean energy future. The integration of digital technologies and artificial intelligence in renewable energy systems also presents new avenues for optimization and efficiency. Future trends in the renewable energy sector include the development of offshore wind farms, the expansion of distributed energy systems, and the emergence of new business models such as energy-as-a-service (EaaS) (which is a business model where customers pay a recurring subscription fee rather than making an upfront capital investment into energy assets).

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ENERGY NEWS BRIEF

March, 2024

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CEE Group Acquires 80.9 MWp Solar Park in Brandenburg, Expanding Renewable Energy Portfolio

The CEE Group, a Hamburg-based asset manager, has significantly grown its green energy portfolio by acquiring an 80.9 MWp solar park in Brandenburg. This addition brings their project count to 101, with 54 solar and 47 wind parks, totaling 1.9 gigawatts. They now supply green energy to 885,300 households, preventing nearly 1.5 million tons of CO2 emissions annually. In addition, they activated a 154 MWp solar park in Döllen, becoming Germany's third-largest solar site. With assets worth EUR 2.6 billion, CEE Group aims to expand its renewable energy portfolio to 2.5 gigawatts by 2024 and increase to 6.0 gigawatts within five years through repowering and hybridization strategies, anticipating up to a 200% increase in total output.

Veolia Study Shows UK's First Carbon Capture Tech for Sustainable Fuel Production

Veolia has developed a system using Advanced Amine technologies to capture carbon emissions from non-recyclable biogenic waste combustion. The captured CO2 can be combined with green hydrogen to produce eMethanol and Sustainable Aviation Fuel, reducing carbon intensity in shipping and air travel. This innovation could help Veolia's UK Energy Recovery Facilities save over 100,000 tonnes of carbon annually. The technology can be integrated into existing sites for near-zero or negative CO2 emissions power generation. Veolia's COO, Donald Macphail, believes this advancement will cut emissions from Energy Recovery Facilities, aligning with their ecological transformation goals. Veolia operates ten ERFs in the UK, converting waste into electricity and reducing fossil fuel use.

Santos secures $150m to fund Moomba CCS project in Australia

Sntos has secured $150m (A$228.88m) in financing for its share of the Moomba carbon capture and storage (CCS) project in South Australia. The financial backing will cover the costs incurred to date and support the $220m project as it advances towards its first CO_2 injection, scheduled for mid-2024. Currently 80% complete, the Moomba CCS project aims to achieve life cycle break-even storage costs of around $24 per tonne. The project is expected to have an annual storage capacity of up to 1.7 million tonnes of CO_2, permanently and safely stored in depleted natural gas reservoirs. Santos CEO and managing director Kevin Gallagher said the competitive rates offered by banks for energy transition projects reflect their acknowledgment of CCS as an essential component for achieving global net-zero goals.

Ørsted says Maryland's 966-MW Skipjack offshore wind project

Ørsted is repositioning the Skipjack Wind project, a 966-MW project off the coast of the Delmarva peninsula in Maryland, for future offtake opportunities. They have withdrawn from the Maryland Public Service Commission Orders approving the Skipjack 1 and 2 projects due to challenging market conditions. Ørsted will continue advancing development and permitting for the combined project and is exploring various opportunities for its future. They are also progressing with other offshore wind projects in the U.S., including the South Fork Wind project in New York and the Revolution Wind project delivering power to Rhode Island and Connecticut.

Egypt signs 7 green hydrogen and renewable energy deals worth around $40 bln

Egypt has signed seven green hydrogen deals potentially worth $40 billion, attracting investments to the Suez Canal Economic Zone. The agreements involve international developers committing to invest over a 10-year period. A pilot program is expected to receive around $12 billion, followed by an additional $29 billion for the first phase. The Sovereign Fund of Egypt has seen growing interest from investors in green hydrogen projects, indicating a positive direction for the country's green energy initiatives. These deals aim to position Egypt as a regional hub for green energy and contribute significantly to the National Green Hydrogen Strategy's goals, including reducing carbon emissions and expanding Egypt's role in the global hydrogen market.

Econergy, Rivage partner on £128 million European solar investment

Econergy and Rivage Investment have partnered to fund £128 million in European solar PV projects. The funding supports ongoing development in Econergy's key markets of Italy, Poland, the UK, and Romania. Rivage Investment will provide two-thirds of the loan initially, with the final third starting on June 30, 2024. Econergy acquired UBS's share in its Italian projects, gaining full ownership of around 440MW once operational. Debt financing was arranged by Marathon Capital for Econergy, with legal advice from Ashurst for Rivage Investment and Squire Patton Boggs for Econergy. Econergy's 155MW Ratesti PV Plant in Romania began commercial operations in November 2023, supplying electricity to the grid shortly after.

Wärtsilä to deploy BESS solution at 600MWh Scotland project

Wärtsilä will deploy its new Quantum High Energy battery energy storage system for a 300MW/600MWh project in Scotland. The BESS will be delivered to Zenobē Energy, a UK-based developer and investor in energy storage and EV charging solutions. The project, located in Kilmarnock, aims to integrate wind energy onto the grid and is expected to be completed by the end of next year. The project has received funding from National Grid ESO to help stabilize the grid as it transitions to renewable energy sources. Zenobē's Kilmarnock South BESS has been designated as an NOA Stability Pathfinder project to support the grid's transition away from thermal power generation to renewables.

SECI Launches Competitive Bidding for 1200 MW Wind-Solar Hybrid Projects in India

SECI has issued an RfS for the development of 1200 MW Wind-Solar Hybrid Power Projects connected to ISTS. Interested developers can participate by paying the document fee and bid processing fee through NEFT/RTGS transfer. The deadline for bid submission is March 29, 2024, for soft copies and April 2, 2024, for hard copies. The selected HPD will be responsible for establishing the projects and necessary transmission network. The scheme allows for the deployment of Wind-Solar Hybrid Power Technology with a total contracted capacity of 1200 MW. Individual bidders can submit a single bid for a minimum of 50 MW and a maximum of 600 MW. The projects can be located anywhere in India, chosen at the discretion of the bidder.

Daman and Diu Electricity Department Tender: 7.47 MW Solar PV Plant Project in Diu with O&M

The Electricity Department of Daman has issued a tender to expand solar power facilities in Diu, aiming to increase the capacity of existing solar PV plants by a substantial amount. The tender, valued at ₹34 crore, includes installation, operation, and maintenance of the plants. The bidding process closes on 27th February 2024, with a pre-bid meeting scheduled for 22nd February 2024. The project signifies a step towards sustainable and green energy solutions in the region.

Sunsure Energy Unveils Brand Refresh, Aims for 5 GW Green Energy Target by 2028

Sunsure Energy, a key player in India's renewable energy sector, refreshed its brand after 10 years to highlight its green energy commitment. The company plans to develop 5 GW of renewable energy assets by 2028. The new logo symbolizes solar energy and their mission to lead India's green transition. With the tagline 'Making India's Power Move,' they aim for energy independence and net-zero by 2070. Sunsure Energy focuses on guiding industries towards sustainable energy, leading India's energy sector with innovative solutions. Their brand update signifies a milestone as they drive India's transition to green energy, aiding businesses in achieving sustainability goals.

Powering Africa Summit 2024: Uniting for Sustainable Energy Transition

High-Level African Energy Summit to Drive Capital Flows and Energy Transition will convene in Washington D.C. on March 5-6. Ministers and government officials from Nigeria, Egypt, Ethiopia, Sudan, Zimbabwe, Malawi, Senegal, Eswatini, Djibouti, and São Tomé & Príncipe will gather alongside sponsors, African utilities organizations, regulators, and Development Finance Institutions. The summit will focus on lowering Africa's cost of debt, resolving the Sovereign Guarantee Impasse, and shaping a more suitable finance roadmap for the future. Power Africa will facilitate collaborative discussions. The summit aims to foster further progress and showcase success stories as thought leaders, investors, and decision-makers converge to advance Africa's equitable energy transition.

Octopus Energy and AeroVolt collaboration enables charging of electric aircraft with one tap of a card

The collaboration between Octopus Energy and AeroVolt enables easy charging for electric aircraft. Octopus Electroverse, a top electric vehicle charging platform, will integrate with AeroVolt, the UK's first aircraft charging network. This partnership aims to provide electric plane pilots convenient access to charging at AeroVolt's airside chargers nationwide. Electric planes have a lower climate impact than traditional fossil fuel aircraft. AeroVolt currently has charge points at seven UK sites, with more planned. Octopus Energy's efforts to promote electric transport include seamless charging for electric cars and aircraft. Their commitment to green transport and sustainability aims to facilitate a smooth transition to electric mobility for pilots and drivers.

Waaree showcases 420 W mono PERC flexible solar modules

Waaree introduced new 420 Wp mono PERC flexible, lightweight solar modules at Intersolar India These modules, part of the FLW series, are designed to seamlessly integrate into various environments where traditional rigid panels may face challenges. Waaree offers customized solutions ranging from 3 Wp to 500 Wp, with options for white or black backsheets and mounting choices. The modules feature scratch-resistant composite glass polymer and multiple encapsulant layers for flexibility and durability. They are up to 70% lighter than conventional panels, suitable for rooftops, electric vehicles, portable power solutions, and military applications. Additionally, they are optimized for performance in scattered light and extreme weather conditions, compatible with various battery types.

Troubled green giant Ørsted names new CFO and operations chief

Ørsted has appointed Trond Westlie as its new CFO and Patrick Harnett as its new COO to address its financial issues. Westlie will replace Rasmus Errboe, who has been acting as interim CFO since mid-November 2023. Harnett will replace Andy Brown, who stepped down as interim COO. Ørsted announced a downgrade in its ambitions, including reduced renewables build targets, job cuts, fixed costs reduction, market exits, and “leaner development” in floating wind.

Eolus applies for 1GW Blekinge Offshore wind project in Sweden

The Blekinge Offshore wind farm, located 11km offshore Sweden, is a 1GW offshore wind project developed by Swedish renewable energy developer Eolus and the local company Vingkraft. An application for an environmental permit has been filed, and the wind farm is expected to comprise 70 wind turbines generating 4.3TWh of renewable electricity annually. The technical conditions are favorable, with shallow waters and proximity to the power grid, allowing for construction with existing technology.

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Global Energy Events

2024 Intersolar North America and Energy Storage North America

Date: From 16 to 19 Jan 2024
Location: San Diego Convention Center 111 Harbor Dr.San Diego, CA 92101

Intersolar North America and Energy Storage North America highlight the latest energy technologies, services, companies, and organizations striving to create a positive impact on climate change and support our planet's transition into a more sustainable energy future.

Website: www.intersolar.us
Registeration: www.xpressreg.net

Electrical Energy Storage and Technologies Conference

Date: From29 to 30 Jan 2024
Location: San Diego San Diego, US

EESAT has been the leading technical forum for showcasing advancements in energy storage technologies and applications since 2000. It is currently sponsored by the IEEE Energy Storage and Stationary Battery (ESSB) Committee.

Website: www.cmte.ieee.org
Registeration:www.cmte.ieee.org

Hydrogen Live 2024

Date: From 7 to 8 February 2024
Location: Titanic Hotel, Rum Warehouse, Liverpool United Kingdom

Foresight Hydrogen Live 2024 is a premier event focusing on the hydrogen value chain. Taking place on February 7 and 8 at the Titanic Hotel in Liverpool, it offers a valuable opportunity for industry leaders, innovators, policymakers, and investors to collaborate and influence the future of hydrogen.

Website: www.decarbonisationtechnology.com
Registeration: www.decarbonisationtechnology.com

Egypt Energy Show

Date: From 19 to 21 February 2024
Location: Cairo

The EGYPES 2024 Conferences help shape the future energy agenda to unlock the potential of the energy transition and drive sustainable production and climate-conscious practices. The EGYPES strategic dialogue focuses upon the need for a new global energy system, one that reduces reliance on single energy sources and supports supply and demand cycles globally.

Website: www.egypes.com
Registeration: www.egypes.com

Go Hydrogen Business Summit 2024

Date: From 21 to 22 February 2024
Location: Antwerp Belgium

Go Hydrogen is a business summit focused on practicality, covering important projects, production, and emerging technologies in the hydrogen economy. The summit aims to provide a meeting platform for project owners and off-taker companies to network and conduct business together.

Website: www.decarbonisationtechnology.com
Registeration: www.decarbonisationtechnology.com

Wind Energy Asia 2024

Date:From 6 to 8 March 2024
Location: Taiwan

Wind Energy Asia is the only wind industry-focused tradeshow in Taiwan. Thanks to its knowledge and vast connections into the local supply chain allied with its international reputation, Wind Energy Asia provides great business opportunities by gathering international and local players on the best networking platform for the wind industry in Taiwan.

Website: www.windenergy-asia.com
Registeration: www.futureenergyasia.com

Waterpower Week

Date: From 13 to 15 March 2024
Location: Capital Hilton in Washington, D.C.

Waterpower Week 2024 has support opportunities that fit the needs of your budget and will help you surpass your company's marketing goals.

Website: www.waterpowerweek.com
Registeration: www.edgereg.net

International Conference on Renewable Energy and Sustainable Energy (ICRESE-2024)

Date: From 25 to 27 March 2024
Location: Paris, France

The conference offers a dynamic blend of expert keynotes, interactive workshops, and unparalleled networking opportunities, fostering collaborations that will shape the course of Renewable Energy and Sustainable Energy technology.

Website: www.conference2go.com
Registeration: www.renewableenergy.com

26th World Energy Congress

Date:From 22 to 25 April 2024
Location: Rotterdam Ahoy, Rotterdam, the Netherlands

The 26th World Energy Congress is a critical turning point for leadership on clean and inclusive energy transitions worldwide and an opportunity to spring forward in redesigning energy for people and planet.

Website: worldenergycongress.org
Registeration: www.worldenergycongress.org

Solar & Storage Live Story

Date: From 1 to 2 May 2024
Location: Brisbane Convention & Exhibition Centre

Solar & Storage Live is the world's largest series of trade shows and conferences organised globally by Terrapinn Limited in the UK, USA, South Africa, Egypt, Saudi Arabia, Philippines, Thailand and Vietnam etc..., and coming to Brisbane Australia in May 2024.

Website: www.terrapinn.com
Registeration: www.secure.terrapinn.com

CLEANPOWER 2024 Conference & Exhibition

Date: From 6 to 9 May 2024
Location: Minneapolis, MN | Minneapolis Convention Center

CLEANPOWER® is the clean energy industry's premier event, bringing policy leaders, industry experts, and major players together for a week of learning, networking, and innovation.

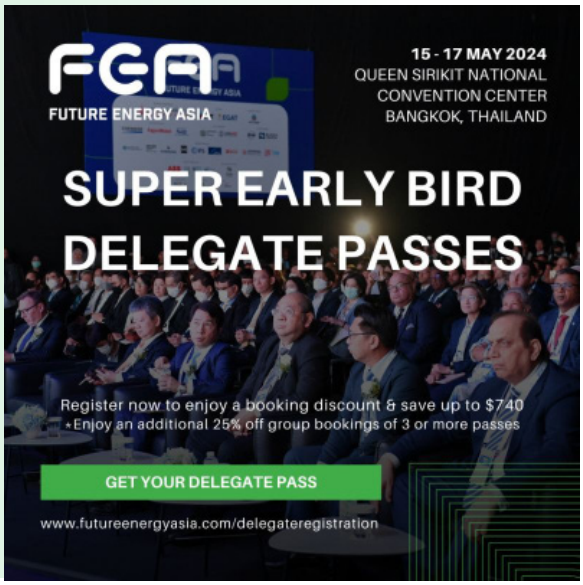
Website: www.cleanpower.org
Registeration: www.xpressreg.net

Future Energy Asia

Date:From 15 - 17 May 2024
Location: In Asia

In 2024, Future Energy Asia will host international ministers, Energy CEOs, policymakers, and technical experts to analyze energy trends, drive innovations for the transition to net zero, and build partnerships for accessible, secure, and affordable energy for all.

Website: www.futureenergyasia.com
Registeration: www.futureenergyasia.com



PV ModuleTech USA

Date:From 21 to 22 May 2024
Location:Napa, USA

This event will address the module landscape that is expected to unfold for U.S. buyers in the coming years; in particular new domestic manufacturing. Special attention will be given to the module offerings, full value-chain traceability and the financial health of the companies currently supplying the market.

Website: www.pv-tech.org
Registeration: www.moduletechusaenergyevents.com

Energy Powering Opportunity

Date:From 11 to 13 June 2024
Location: BMO Centre at Stampede Park - Calgary, Canada

The Global Energy Show Canada is the largest B2B exhibition and conference engaging with industry buyers and sellers, stakeholders and partners, CEOs and young professionals together to share knowledge and fuel innovation in the ever-changing energy landscape.

Website: www.globalenergyshow.com
Registeration: www.globalenergyshow.com

Hydrovision International

Date: From 15 to 18 July 2024
Location: Denver, Colorado, USA | Colorado Convention Center

The conference and exhibit provide an unparalleled platform for learning and procurement that addresses every facet of hydropower, spanning Operations and Maintenance, Environmental Issues and Water Management, Equipment and Technology, Industry Trends and Analysis, and New Development.

Website: www.hydroevent.com
Registeration: www.hydroevent.com

2024 World Battery & Energy Storage Industry Expo (WBE 2024)

Date: From 8 to 10 August 2024
Location: Guangzhou, China

WBE has developed into a professional exhibition with the largest number of exhibitors in battery enterprises and the highest participation of professional visitors and foreign buyers. Relying on its worldwide influence and thousands of overseas buyers.

Website: www.en.battery-expo.com
Registeration: www.en.battery-expo.com

ICBR 2024 International Congress for Battery Recycling

Date:From 10 Sep to 12 Sep 2024
Location: Basel, Switzerland

ICBR 2024 is the global platform for addressing challenges in the battery recycling industry. For 29 years, ICBR has united experts and decision makers from the entire battery recycling value chain, including recyclers, manufacturers, collection organizations, OEM's, policymakers, materials and services providers, and more.

Website: www.events.icm.ch
Registeration: www.events.icm.ch

WindEnergy Hamburg 2024

Date: From 24 to 27 September 2024
Location: Hamburg, Germany

WindEnergy Hamburg is one of the world's biggest and most important wind business platforms for exchanging news and views, building networks and closing major deals. National and international wind industry associations cooperate with WindEnergy Hamburg and encourage their members to attend.

Website: www.windenergyhamburg.com
Registeration: www.windenergyhamburg.com

The Energy Event of Finland

Date: From 22 to 24 October 2024
Location: Tampere

The largest energy event in Finland brings together energy production, power transmission and storing, energy users, environmental and circular economy and real estate decision makers under the same roof in October. The event will showcase sustainable, smart, productive, and modern solutions to the energy transition.

Website: www.energiamessut.expomark.fi
Registeration: www.energiamessut.expomark.fi

HYDRO 2024

Date:From 18 to 20 November 2024
Location: Messe Congress Graz (MCG), Austria

The HYDRO 2024 Technical Exhibition will showcase the most active and innovative companies in the hydropower and dams industry worldwide. Click on the button below to see the latest list of exhibitors, or to book a stand.

Website: www.hydropower-dams.com
Registeration: www.hydropower-dams.com

6th Annual International Summit and Exhibition Balkan's Power

Date:From 4 to 5 December 2024
Location:Sarajevo, Bosnia and Herzegovina

6th Annual International Summit and Exhibition: Balkan's Power is a professional platform, bringing together chief ministers, major investors, decision-makers of the leading hydro, wind and solar power plants and investment project initiators, as well as regulators, to consolidate efforts focused on efficient implementation of key projects for the construction and reconstruction of power plants across Balkan region.

Website: www.balkanspowersummit.com
Registeration: www.balkanspowersummit.com

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