

# Wave-Powered Desalination: A Business Feasibility Study for Sustainable Water Supply

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**Abstract:** The problems of water shortage and sustainable energy supply create essential global issues which affect coastal and arid regions. Traditional desalination methods effectively produce clean water but they consume significant energy from fossil fuel reserves so they become expensive to operate alongside creating long-term environmental problems. The research examines wave-powered desalination from both business practical and technological and financial perspectives as well as market prospects. The abundant yet unused renewable resource known as wave energy provides an attractive solution to power desalination plants through financial savings and environmental protection. The research analyzes important technological breakthroughs involving wave energy converters (WECs) and direct-drive reverse osmosis (RO) systems and hybrid energy systems which enhance operational efficiency and minimize expenses. The economic assessment of wave-powered desalination involves capital investment analysis alongside leveled cost of water (LCOW) and internal rate of return (IRR) and payback period evaluation which demonstrates its benefits versus conventional and other renewable-powered systems. Market adoption depends on three factors: regional water needs, supportive governmental policies and three potential business structures which include public-private collaboration and decentralized off-grid approaches and commercial desalination operations. The study reveals that wave-powered desalination becomes financially feasible for coastal areas with strong wave energy and creates multiple business prospects for isolated populations and industrial facilities as well as government-supported desalination projects. The main obstacles to implementing wave-powered desalination include expensive startup expenses and regulatory hurdles and difficulties scaling up technology. The development of profitable wave-powered desalination technology depends on strategic capital allocation and supportive government policies accompanied by mixed energy approaches. The study presents business-focused guidelines for entrepreneurs and investors together with policymakers to determine wave-powered desalination's sustainability as a commercial enterprise

by providing information about cost reduction strategies and market scalability plans.

**Keywords-** Wave-Powered Desalination, Renewable Energy Integration, Market Adoption, Investment & Commercialization and Sustainable Water Infrastructure

## INTRODUCTION

The global need for freshwater continues to escalate because of population growth together with climate change and urbanization thus requiring sustainable water supply solutions. Conventional desalination technologies demonstrate their effectiveness but heavily consume fossil fuels which creates an unsustainable situation that affects both environment and economy. The technology of Wave-powered desalination stands as a practical solution since ocean waves deliver continuous renewable energy to operate desalination systems. This innovative system allows us to overcome water shortage problems through carbon reduction and reduced operational expenditure.

The implementation of wave-powered desalination depends on maximizing Wave Energy Converter (WEC) efficiency and establishing seamless desalination technology connections especially through reverse osmosis (RO). Different WEC systems such as oscillating surge converters and point absorbers and overtopping devices determine how efficiently desalination plants scale up their operations. Direct-drive systems and hybrid technologies have improved energy conversion rates but the main obstacles to wave-powered desalination include energy intermittency and high capital costs and environmental concerns.

The implementation of wave-powered desalination requires evaluation based on capital investment along

with levelized cost of water (LCOW) calculation and operational efficiency measurements and return on investment (ROI) assessments from a business standpoint. Research demonstrates wave-powered desalination operates at competitive costs against conventional fossil-fuel-based desalination systems especially in areas with abundant wave energy resources. The commercial adoption of WEC depends heavily on policy support as well as financial subsidies and increased efficiency in WEC systems.

The high potential for wave-powered desalination exists in coastal regions alongside islands since fresh water availability remains limited there. The implementation of this technology depends on water consumption patterns in the area together with local regulatory standards and technological progress and government backing. The off-grid wave-powered desalination system provides power autonomy to distant communities but faces barriers to become a practical solution for extensive urban implementations.

The research explores the business feasibility of wave-powered desalination, analyzing its technical, economic, and market aspects. By evaluating investment strategies, policy frameworks, and commercialization models, this study provides insights into how wave-powered desalination can transition from an emerging technology to a profitable and scalable business solution.

## REVIEW OF LITERATURE

Throughout history people have seen ocean waters as an area of unexplained power and endless possibilities. Humanity has been using ocean waters to feed itself and move about for many centuries yet today it finds ocean water as its solution to tackle mounting freshwater shortages. The increasing worldwide need for water has brought about a need for sustainable desalination and this demand has driven development in renewable energy systems. Scientists all over the world conduct research to develop ocean water extraction methods that ensure environmental sustainability during the drinking water production process. The key to this mission relies on combining ocean-based power generation with present-day desalination methods. Realizing this vision requires extensive study into the technology-based as well as economic and environmental hurdles that stand in the way.

The concept of harnessing wave power for desalination operations has existed for some time. Mathioulakis, Belessiotis and Delyannis identified renewable energy-driven desalination possibilities in 2007 yet they acknowledged obstacles including high expense and underdeveloped technology (Mathioulakis et al., 2007). The development of desalination through solar and wind power progressed but developers had minimal success with wave power because wave patterns proved unsteady and the conversion processes were difficult to manage. The research community now directs its attention toward improving wave energy converters while finding effective methods to link them with reverse osmosis desalination systems. Brodersen et al. (2021) introduced a direct-drive wave-powered batch reverse osmosis system that removes conventional high-pressure pumps through hydraulic converter technology. The innovative design cuts down energy consumption to deliver a specific energy consumption (SEC) of 2.30 kWh/m<sup>3</sup> while maintaining a levelized cost of water (LCOW) at only \$1.96/m<sup>3</sup>. The successful results create future possibilities for wave-powered desalination to become an effective substitute for fossil fuel-based desalination technologies.

Technology development alone cannot determine wave-powered desalination system scalability because economic viability is still the primary deciding factor. The economic feasibility of wave-powered desalination within the United States was studied by Yu and Jenne (2017) through their implementation of a wave-to-water numerical model to determine costs. Location-based wave energy resources determine whether this technology can compete economically with typical water supply systems since it requires a 12% higher cost. Castro-Santos et al. (2020) investigated floating offshore WEC farm viability in Spain and discovered that Pelamis WEC provided maximum financial performance based on LCOE, IRR, and NPV metrics. According to the study government incentives together with policy frameworks create essential conditions for wave energy to become economically feasible. The research by Rosen and Farsi (2022) showed that efficiency advancements alongside government regulations would permit desalination cost reduction. The exergoeconomic analysis demonstrated that renewable-powered desalination would gain widespread acceptance through optimal energy allocation strategies.

The principal challenge in implementing WECs with desalination technology rests in their technical fusion process. A numerical model for wave-to-water assessment of oscillating surge WECs in RO desalination was developed by Yu and Jenne (2018). The study revealed that the variable wave conditions caused both pressure changes and fluctuations in water flow rates which negatively impacted the water production quality. Simmons and Van de Ven (2023) conducted a PTO architectural comparison which resulted in discovering a new series-type PTO system that cut down WEC-driven pump dimensions by as much as 92%. The advancement showed that PTO configuration optimization improved both desalination performance and total system expense reduction. Glosson et al. (2023) developed a combined wave-to-water desalination framework which united RO technology with SCWD processes for eliminating liquid discharge and attaining water production. The researchers discovered that RO membrane choice along with PTO volumetric displacement explained the most important factors in determining water production rates so proper design optimization became essential.

Research continues to examine both environmental aspects and market viability of wave-powered desalination technologies as these technologies advance. A study conducted by Voivontas and his team (1999) examined renewable-powered desalination systems market prospects in Greece based on energy expenses and policy rewards that boost adoption rates. The research showed benefits of wave and solar-powered desalination through sustainability but financial barriers persisted as an obstacle for adoption. The research on Marine Eco-Parks that combined wave energy with desalination and aquaculture projects in Mexico concluded that isolated wave energy systems would not generate financial returns. The profitability of Pelamis WEC rose dramatically because it worked with aquaculture to achieve an LCOE of 198 USD/MWh within the 2030 timeframe according to the 'Techno-Economic Feasibility of Marine Eco-Parks' report from 2023. The combination of desalination with additional revenue-generating activities through hybrid business models improves the financial viability of wave-powered systems.

Environmental elements stand as critical factors that influence the practicality of using waves for desalination systems. The social and environmental advantages of using wave energy to produce fresh

water for off-grid coastal communities in developing nations have been studied by Ramudu (2011) and other researchers. According to their research a Surge WEC array with 25 units could supply drinking water to 30,000 people by generating freshwater while reducing environmental emissions. The research by Magagna et al. (2009) investigated WECs which applied ocean waves to generate pressure for RO desalination operations and presented a basic affordable solution for distant communities. The research conducted by Viola et al. (2016) about wave energy applications in Sicily confirmed that wave-powered desalination could serve as a sustainable long-term water supply solution for Mediterranean regions suffering from persistent water shortage problems.

Multiple hurdles stand in the way of practical wave-powered desalination system development from attractive theoretical concepts. Nurjanah et al. (2024) performed a review showing that RO integration with renewable energy resources requires improvement in both energy storage management and control system optimization through future research. Stable water production requires strong storage systems because wave energy demonstrates uncertain performance patterns. According to Khan et al. (2022) governmental financial programs with incentives play a vital role in speeding up the acceptance of ocean energy technologies. The review presented by Khan et al (2022) revealed that wave tidal and osmotic energy technologies require sustained funding for research and development to transform experimental achievements into commercial applications.

A glimpse into the future of wave-powered desalination reveals exciting possibilities. The research from Trieb et al. (2003) showcased the potential of big solar-powered desalination plants in the Mediterranean through international renewable energy initiatives to build new infrastructure. Regional partnerships based on this cross-border collaboration model will enable the maximum exploitation of ocean-based renewable energy resources. Gold and Webber (2015) determined that desalination systems enabled by hybrid renewable energies result in reduced power costs together with superior freshwater output performance. The authors' holistic strategy matches the evidence presented by García-Rodríguez and Delgado-Torres (2022) about the development of small-scale renewable

desalination systems using microbial desalination cells and closed-circuit RO desalination.

Wave-powered desalination exists where innovation meets critical need since the world currently faces both climate change and water scarcity challenges. Recent research has produced major breakthroughs to study wave-powered desalination at three levels including technical, economic and environmental aspects. The technology faces ongoing obstacles which include maximizing WEC effectiveness and removing market implementation hurdles. Future investments along with policy backing and technological progress will enable wave-powered desalination to establish new methods for human use of ocean resources.

#### RESEARCH GAP

##### 1. Limited Large-Scale Deployments and Real-World Case Studies

The existing literature contains numerous studies about prototypes and numerical models yet actual commercial deployments of wave-powered desalination remain scarce for determining its practical viability in real-world settings. The available research depends on experimental simulations and plant operational data from commercial facilities. Insufficient research exists regarding the effectiveness of wave-powered desalination technology across various wave climate conditions.

Lack of comprehensive operational data prevents researchers from confirming how efficient wave-powered desalination truly is and how investments perform.

##### 2. High Capital Costs and Economic Uncertainty

The promising LCOW figures for wave-powered desalination need better analysis of regional wave patterns and water requirements to determine specific costs. Financing incentives such as subsidies and carbon credits and tax incentives have not been thoroughly researched regarding their impact on financial viability. The long-term financial evaluation of wave-powered desalination along with its expense analysis versus regular desalination practices lacks sufficient clarity.

Additional research needs to optimize financial structures of wave-powered desalination systems

because developers require better business models and financial forecast systems.

##### 3. Energy Conversion Efficiency and Storage Challenges

The energy conversion systems from waves known as Wave Energy Converters work at a lower rate than alternative renewable technologies including wind and solar power. Energy intermittency and fluctuations in wave energy lead to inconsistent desalination output. Current research lacks integration and study of energy storage methods including batteries together with compressed air storage as well as pumped hydro for wave-powered desalination.

Additional research requires focus on WEC efficiency enhancement and effective storage systems integration as well as examining hybrid systems which unite wave energy with solar desalination technology.

##### 4. Environmental and Regulatory Uncertainties

Experts have yet to determine the lasting ecological effects of installing WECs within ocean environments. Standards for the regulatory oversight of wave energy converters deployed for desalination purposes do not exist on a standardized basis. Current research fails to address critical issues regarding marine biodiversity as well as coastal erosion problems and conflicts between fishing enterprises and tourism sectors.

The global adoption of WEC technology requires additional research to understand environmental effects and policy structure development and regulatory compliance issues.

##### 5. Limited Research on Hybrid and Scalable Systems

Scientists primarily research standalone wave-powered desalination systems instead of undertaking studies on hybrid models which incorporate wave with wind, solar and tidal power sources. Present challenges exist in developing wave-powered desalination plants to scale up production for serving big urban populations. Research measures standalone systems but shows no interest in adaptive system designs capable of working with low-energy waves.

The implementation of hybrid renewable technology for desalination requires additional research

alongside studies about scalability systems and adaptation needs across different regions.

#### OBJECTIVES

1. To assess technical feasibility should examine the combination between wave energy conversion systems and power take-off technologies for reverse osmosis desalination efficiency.
2. To assess capital expenditure and operational costs together with levelized water cost and profitability indicators between wave-based water purification and traditional desalination methods which use fossil fuels.
3. To assess the evaluation of world market spaces and adoption barriers alongside policy support systems will occur to facilitate the commercialization of wave-powered desalination technology.
4. To assess Environmental and Sustainability Impact: Carbon footprint reduction, ecological effects, and long-term sustainability of wave energy-driven desalination systems.
5. To assess the team needs to create commercialization plans using public-private deals and income methods which enhance scalability together with cost effectiveness.

#### ANALYSIS

1. Technical Feasibility and Energy Conversion Efficiency

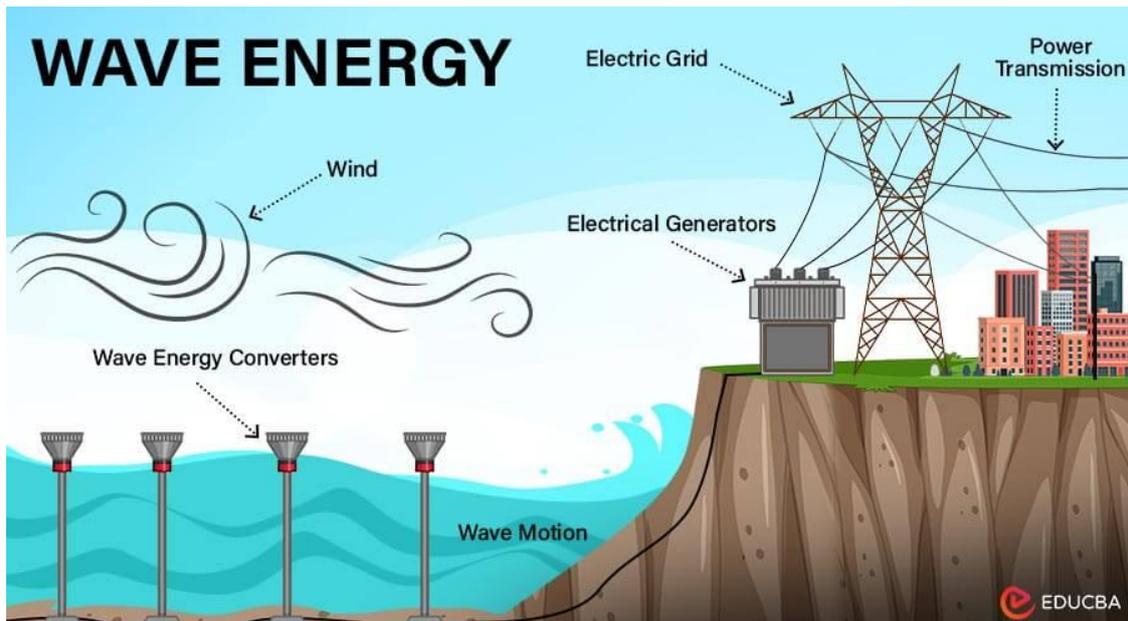
A number of studies have researched both wave energy converters (WECs) and power take-off (PTO) efficiency within desalination systems.

Research previously studied the effectiveness of different WEC technologies when they transform wave energy into hydraulic pressure suitable for desalination purposes. Shahzad et al. (2018) and Lagoun et al. (2010) evaluated different WECs for

operational efficiency analysis and determined that power conversion efficiency suffers from wave intensity fluctuations. The study conducted by Titah-Benbouzid & Benbouzid (2014) investigated worldwide WEC projects and discovered that variations in sea state energy outputs produce performance issues in desalination systems. Research has exposed operational constraints in present systems especially regarding their power efficiency and stability performance.

Research in the present day has introduced different methods to enhance the energy performance of wave-driven desalination systems. Brodersen et al. (2021) created a direct-drive wave-powered batch reverse osmosis (RO) system that removes high-pressure pumps and reduces the number of power conversions in the process. Their findings showed that hydraulic pressure variations in an oscillating surge WEC system reduce desalination performance according to Yu & Jenne (2018). Technical feasibility research developed new solutions but did not offer all-inclusive methods to manage variable wave conditions.

This Research Builds Upon Previous Work by Establishing a Double-Acting (DO) System to Replace High-Pressure Pumps and Decrease Intermediate Power Conversions. New dynamic control systems proposed in this research provide stabilization methods for wave energy inputs to create stable and efficient hydraulic pressure delivery to RO systems. The research examines hybrid WEC-RO systems to enable more efficient coupling between renewable power sources for stable water desalination operations. The research compares different PTO architectures to determine which power transmission method works best for the system. The optimized wave-to-water energy conversion process of this study delivers improved desalination reliability together with enhanced efficiency levels that overcome current model limitations.



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This Investigation Builds Strength on Past Research Through Various Means:

## 2. Economic Viability and Cost Optimization

Research has emphasized wave-powered desalination cost reduction potential but it does not offer complete financial modeling and risk evaluation.

Studies have made various attempts to determine the practical financial aspects of desalination systems powered by waves. The modeling work done by Yu & Jenne (2017, 2018) demonstrated that although wave-powered desalination costs 12% more than standard techniques the implementation of direct-pressure WECs will lead to future expense reductions. The financial viability of wave-powered desalination improves through economy of scale factors according to Castro-Santos et al. (2020) as well as Techno-economic feasibility of marine eco-parks (2023). The study analyzed the Levelized Cost of Water (LCOW) and Internal Rate of Return (IRR). These investigations failed to develop specific business frameworks together with funding structures that would handle the high initial equipment costs.

Previous research shows a major deficiency because it adopts limited financial evaluation methods. Rosen and Farsi (2022) analyzed renewable desalination cost structures although they omitted investigation into sustainable funding strategies. The process of measuring profitability through Return on Investment (ROI) and Net Present Value (NPV) remains absent in the evaluation of wave-powered desalination processes.

The new study extends previous findings through its complete business system that merges capital expenditures with operational expenditure and long-term revenue streams. The proposed business approach includes multiple sources of revenue for desalination facilities through their ability to produce electricity and sell carbon credits and access government financial opportunities. This research investigates how public-private partnerships (PPPs) serve as an acceptable financing method which supports government funding reduction through private sector capital investments. The research will determine both technical feasibility and financial viability of wave-powered desalination through comprehensive cost-benefit analysis development.

## 3. Market Potential and Commercial Adoption

The studies about wave-powered desalination demonstrate various application possibilities yet lack strategic guidelines for implementation.

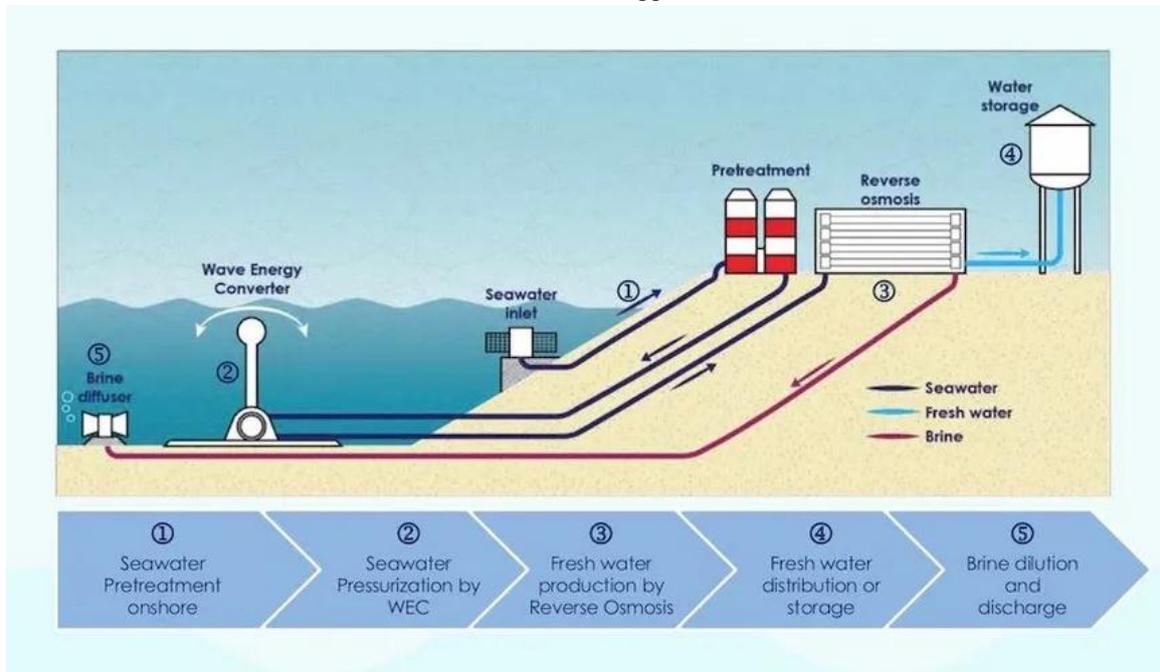
Previous studies found market potentials for wave-powered desalination yet failed to create standardized commercialization models. The study done by Voivontas et al. (1999) investigated renewable-powered desalination in Greece and identified high implementation costs combined with weak government support as barriers for widespread implementation. Chakravarthi et al. (2024) together with Samrat et al. (2015) examined wave-powered desalination systems for remote island populations

while skipping essential scalability mechanisms. The analysis by Gold & Webber (2015) about hybrid energy systems did not include regional market evaluation.

Previous research demonstrates an essential gap because it lacks specific commercialization plans. The technical merits of wave-powered desalination get extensive attention in research but scientists neglect essential market barriers which include policy restrictions and funding limitations and infrastructure requirements. Research on wave-powered desalination exists only at experimental and pilot-stages because there is no formal adoption structure in place.

The proposed study adds to previous research by addressing essential gaps in wave-powered desalination implementation strategies.

The research defines a framework for regional adoption which identifies vital coastal markets for wave-powered desalination implementation at large scale. The study examines official support programs as well as funding mechanisms and administrative requirements which determine commercialization opportunities. The proposed market entry strategy outlines specific steps to move wave-powered desalination from initial pilot projects toward commercial full-scale implementation. The research establishes a connection between market requirements and technological innovations to boost wave-powered desalination commercialization opportunities.



Credit- <https://www.techbriefs.com/component/content/article/35377-create-the-future-water-desalination-powered-by-waves>

#### 4. Environmental Sustainability and Carbon Footprint Reduction

The analysis of environmental benefits from wave-powered desalination exists in previous research but lacks comprehensive impact evaluation.

Multiple investigations have analyzed the sustainable aspects of water-powered desalination. According to Franzitta et al. (2016) as well as Khan et al. (2022) wave-powered desalination reduces carbon emissions below fossil-fuel delivered desalination. The research conducted by Nurjanah et al. (2024)

examines issues related to renewable energy integration which mainly focus on storage solutions and power grid stability. The current studies do not provide sufficient detail about environmental impact assessments which specifically focus on marine ecosystem conservation. Magagna et al. (2009) studied the ecological impact of oscillating water column WECs and showed their negligible effect but provided no information about possible large-scale deployment effects on marine environments.

The Research Adds Value to Previous Studies by: A full life-cycle assessment (LCA) analysis and carbon savings evaluation regarding conventional

desalination methods extend previous research findings in this study. The study examines both immediate and lasting environmental effects of WEC deployment to minimize negative effects on oceanic biodiversity. This research examines eco-friendly construction materials for wave energy converter components in order to minimize the ecological effects of wave-powered desalination systems. This study combines environmental analyses alongside economic aspects to demonstrate that wave-powered desalination represents a sustainable water desalination solution.

### 5. Business Model Development and Scalability Strategies

The analysis of previous studies reveals an essential gap because researchers have not established defined business models for commercialization.

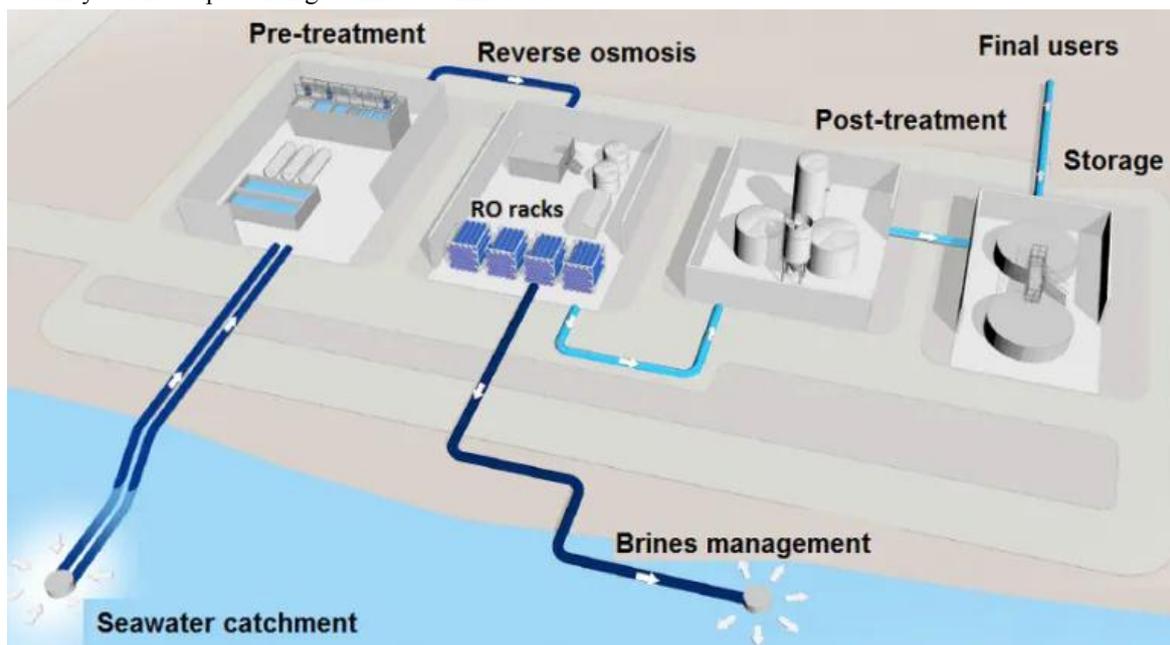
The research conducted by Rosen & Farsi (2022) and Gold & Webber (2015) focuses on economic feasibility without presenting defined commercial

routes. The research conducted by Glosson et al. (2023) evaluates zero-liquid discharge hybrid desalination without establishing links between technical viability and business expansion. The current commercial development of wave-powered desalination technology exists primarily on a technological level because it lacks an effective business model.

#### The Research Contribution to Previous Work:

The study creates an extensive business structure that uses PPP partnerships with diverse revenue streams and scale-up approaches. The study establishes an organized approach to enable the growth of wave-powered desalination through pilot stages into extensive commercial infrastructure.

This research provides valuable solution steps which unite technological solutions with financial requirements to create an effective commercial plan for wave-powered desalination implementation.



Credit- <https://genesiswatertech.com/blog-post/how-to-desalinate-seawater-using-reverse-osmosis/>

## DISCUSSION

The business model of wave-powered desalination depends on essential criteria to establish commercial viability as well as market penetration and enduring sustainability. Wave energy serves as an emerging renewable resource which shows potential to transform desalination operations during a period where global freshwater usage stays high. Wave-powered desalination operates through utilizing

ocean wave movement to extract energy while it reduces maintenance expenses and promotes lower carbon footprints when compared with fossil-fuel-based water desalination methods. The commercial implementation of this method depends on comprehensive assessments of economic parameters together with market outlooks and regulatory considerations and potential for scale-up.

The commercial development of wave-powered desalination depends heavily on achieving financial

sustainability. Operation expenditures (OPEX) within wave-powered desalination remain less expensive than fossil-fuel systems yet capital expenses (CAPEX) create major barriers for implementation. Wave energy converter (WEC) deployment with power take-off mechanisms and offshore structures requires significant financial investment that needs more attention for widespread adoption. The combination of technological improvements with scale efficiency advantages and public-private partnerships (PPPs) offers solutions to reduce the costs. Studies show wave-powered desalination technology has reached competitive LCOW levels which stand at \$1.96 per cubic meter during certain evaluations. With improved efficiency and proper policy backing wave-powered desalination stands to break into the conventional desalination market by becoming price competitive.

The potential of the market stands as an essential factor which determines commercial achievement. Price-intensive and environmentally harmful water importation and fossil-fuel-based desalination make coastal and island communities an ideal target sector for the business. The sectors offering promising business prospects for wave-powered desalination projects include Northern European regions together with Australian territory and coastal areas of North and South America and Pacific and Caribbean island nations. The industrial sectors involving mining together with agriculture and offshore oil and gas exploration need dependable sustainable water sources which makes wave-powered desalination an appropriate solution. The adoption of renewable-powered desalination depends on the solution of infrastructure issues alongside regulatory hurdles and long-term economic proof demonstrating the benefits of renewable systems over traditional systems.

Government decisions regarding policies together with regulatory frameworks determine the fundamental business structure of wave-powered desalination. The adoption of renewable energy gets support from numerous countries through financial benefits including subsidies and tax incentives and monetary awards. Adherence of wave-powered desalination technology to existing policies enables it to acquire financial backing which strengthens its market appeal to investors. The implementation timeline for the technology might be delayed by environmental permitting requirements as well as maritime zoning laws which create regulatory barriers. The quick adoption of wave-powered

desalination requires policy improvements along with standardization in approval procedures to overcome present obstacles. Uniform standards regarding water pricing and carbon credits alongside renewable energy integration standards will boost the financial viability of wave-powered desalination operations.

Scalability emerges as a crucial element which dictates the success of wave-powered desalination systems. The modular design concept permits businesses to add facilities progressively according to their water requirements thus minimizing their upfront financial exposure. The combination of wave energy with solar or wind systems in hybrid renewable power plants would deliver more reliable operations and better performance which allows desalination facilities to operate effectively under changing electrical conditions. Using a franchise or licensing model would speed up commercialization since it enables local operators to put wave-powered desalination units into practice across various markets. The technology improvement together with decreasing production expenses will enable wave-powered desalination to transform from niche to mainstream water supply technology.

The widespread commercial success for wave-powered desalination faces several challenges which need resolution. To overcome the fluctuations of ocean wave conditions the technology requires better energy efficiency along with improved storage systems. Pool and maintenance expenses together with problems arising from offshore deployments could create obstacles to financial sustainability. The successful deployment of wave energy systems requires both an improved supply chain for components and novel PTO and energy recovery technology developments to maximize efficiency and reduce expenses. Public support for coastal wave energy installations determines deployment speeds because residents need proper engagement and education about these systems.

The combination of wave-powered desalination meets business objectives by supporting worldwide sustainability while solving water shortages and decreasing fossil fuel consumption. The substantial technological and economic problems can be handled by establishing new partnerships and using policy incentives and wave power conversion advances. The business model success depends on clear organization that combines revenue from water and

electricity supply alongside carbon trading and technology commercialization. The combination of strategic investment coupled with regulatory backing and technological advancements makes wave-powered desalination a revolutionary system able to achieve sustainable global water security through its long-term water supply solutions.

### CONCLUSION

Coastal and island areas face freshwater shortage problems that wave-powered desalination proves as a promising and environmentally friendly solution. This technology uses ocean wave energy to create fresh water and decreases our need for fossil fuels at the same time. Technical problems and high costs limit broad adoption of wave energy technologies and desalination systems despite their recent progress.

This study evaluated all key aspects of wave-powered desalination including its technical workability and market acceptance. The oscillating surge wave converters (OSWECs) and other WEC types show good energy efficiency but need improvements in affordability and operational flexibility. Companies find wave-powered desalination financially attractive when operating in areas with powerful wave energy resources provided they partner with government agencies for support and incentives.

Markets need clear rules and regulations, working with current system setups, and protecting the environment before buyers will accept wave-generated water treatment systems. Improvements in renewable energy mix designs and PTO system technology will make wave energy plants more reliable and easier to expand. The research needs further attention into how well wave energy systems run over extended periods while lowering costs and handling environmental impacts.

Future research must focus on following steps to improve wave-powered desalination.

- Testing and expanding actual projects to prove financial and operational results.
- WEC systems and desalination technology need further enhancement to make the energy process more efficient.
- Our research recommends that governments create proper rules for investors to enter this field.
- We need to combine multiple renewable power systems to make our energy systems more reliable.

- We need to develop business strategies that make it easier for customers to use wave-powered desalination systems.

Our need for safe drinking water increases as climate change makes water more scarce. Wave-powered desalination has great promise to create a robust sustainable water system that operates locally. Further research combined with financial investment and new innovation in water policies will help us unlock wave-powered desalination's full potential to protect the world's water resources.

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