

The most energy efficient and commercially available wave generating system of the world

Amaia Iturri¹

Marketing & Communications Division at Wvegarden

Abstract

Wavegarden was created for the purpose of sharing the exhilarating experience of surfing perfect waves with everyone, everywhere. The enterprise is a cutting-edge engineering company dedicated to the research, design, manufacture, installation and operation of world-class wave generating systems and surfing lagoons. Wavegarden's headquarters are based in the Basque Country near San Sebastian, in northern Spain. After over a decade of R&D and a series of innovative breakthroughs and patents, Wavegarden is considered the market leader in the rapidly emerging sector of dynamic artificial waves.

Keywords: Wavegarden, surf park, wave generating system, surfing lagoons

1. Beyond substantiality

Wavegarden's goal for the next few years is to create the first self-sufficient surf park in the world.

The company creates facilities designed to blend into the natural surroundings, which require minimal civil engineering work and that have very little visual and auditory impact on the environment. Wavegarden's wave generating technology is designed to recuperate and reuse part of the energy created in

1 Amaia Iturri is Strategic Communications Specialist at Wavegarden. E-mail: amaia@wavegarden.com

the wave generation process. With very little energy lost in the transmission of forces from the machinery to the water, efficiency levels could not be any higher. Likewise, clients can also rely on our technical and engineering expertise to ensure that not only the wave generator but the overall facility is as sustainable and natural as possible.

Wavegarden develops all its projects under the premise of respect for the environment, low environmental impact, commitment to sustainability and energy efficiency. The goal is to achieve a "Net Positive Impact" by operating in a sustainable and responsible manner throughout the entire process.

To achieve the above, Wavegarden has five strategic lines of action that have become fundamental principles for promoting the development of these sustainable practices:

1. Optimization of the environment's potential.
2. Optimization of the use of energy and its storage.
3. Water conservation.
4. Optimization of the use of materials.
5. Optimization of operating and maintenance practices.

In fact, by 2021 the company has set itself the challenge of creating self-sufficient facilities. Once again, Wavegarden will continue to lead the market of man-made surfing facilities and maintain its position as a reference in the field of technology, research and development.

The company's main innovations in the field of substantiality, as well as the challenges for the coming years, are detailed below.

- **Energy efficiency:** thanks to an innovative self-designed energy storage system and the high efficiency of the technology, achieved through wave-generated energy recovery, Wavegarden Cove's wave generation system can operate with both self-generated and grid-generated

renewable energies tailored to each project. This directly influences the installations to be 100% energy self-sufficient.

- **Energy consumption:** Currently, the energy cost of the largest wave generated by the Wavegarden system is only 1 kW h for the largest waves and half that for the smallest waves. This makes the consumption 10 times lower than any other system on the market. As a guideline, the energy cost per wave is around 0.10€ (in Spain).
- **Water consumption:** regarding water consumption, Wavegarden Cove surfing lagoons do not consume more water other than what is lost by evaporation. Weather conditions permitting, we always try to compensate the loss with rainwater.
- **Water treatment:** The water treatment technology is the cleanest and most efficient on the market. The latest improvements in the system make it possible to avoid almost 100% the use of chemicals for its treatment.
- **Landscaping and environment:** Wavegarden's team of architects is able to significantly minimize earthworks in the construction of a project. The materials used in the construction of the lagoons are non-toxic and can be recycled. In addition, the modular construction of the wave generator allows the reuse of the elements used. The policy pursued is to conserve the natural habitat and to minimize as much as possible the light and noise pollution in the environment in which it operates. Likewise, in the event that a project is terminated, the non-invasive construction allows the environment to easily return to its original state.
- **Sustainable architecture:** based on minimizing the energy needs of buildings by promoting efficient design and the construction of passive buildings. The policy of reduce, reuse and recycle is encouraged throughout the process. The use of sustainable materials in construction and furnishings is a maxim they always follow.
- **Environmental impact assessment:** All Wavegarden projects are subject to an independent environmental impact assessment to support their approval.

In addition, Wavegarden is committed to the promotion and fulfillment of the Sustainable Development Goals promoted by the United Nations. The following are the objectives that respond to its activity:



Figure 1. Sustainable Development Goals

2. Wavegarden projects

2.1 Successful leisure facilities

Today, Wavegarden has four operational surf parks in different parts of the world. The main features and milestones of each facility are highlighted below.

Wave Park in Siheung (South Korea), opened in 2020, is Asia's biggest surf park is the centerpiece of a new luxury marine complex. Located just 30 min. from Incheon International Airport it's the largest Wavegarden Cove built to date. This installation is equipped with a water heating system that keeps the water temperature above 16°C. This system is based on the use of stored renewable energies to achieve a more efficient and rentable energy management.

- The Reef operated at an average occupancy of over 90% throughout the first three months until its temporary closure.

- Wave Park uses the waste steam energy conversion system to heat the water of the lagoon contributing to energy saving and resource recycling.

Urbnsurf in Melbourne (Australia), was inaugurated in 2019, is Australia's first Surf Park. Located just minutes from Melbourne's Tullamarine Airport, URBNSURF is Australia's first surf park, and the first full size Wavegarden Cove in the southern hemisphere. URBNSURF Melbourne also features a Three Blue Ducks restaurant, offering healthy food and drinks, and incredible views to the surfing lagoon. After only 12 weeks of operation, the numbers speak for themselves:

- 65,000 visitors – with projections for well over 200,000 visits annually.
- The Reefs achieved over 90% average occupancy.
- Bays achieved 80-90% average occupancy during the weekends.

The Wave in Bristol (United Kingdom), opened in 2019 with a surfing lagoon spanning 150m in length, Europe's first public Wavegarden Cove has waves that are suitable for everyone to deliver an unrivalled inland surfing experience. Likewise, is easily accessible by bicycle, car or bus. Early performance of The Wave, before closing due to Covid-19 in March 2020, exceeded all expectations given the winter opening:

- The Reef operated at an average occupancy of over 90% throughout the first four months.
- Even with the cold air and water temperatures, the Bays were surprisingly very busy with beginner lessons at the weekends.

The reopening performance after Covid-19 closure occurred in the peak summer season: Average occupancy (Reef and Bay) of over 85% F&B performing well above expectations.

Surf Snowdonia in North Wales (United Kingdom), opened in 2015, using rainwater to fill its lagoon. Land regeneration may provide additional environmental benefits, with sites dramatically improving as a result of a Wavegarden project. For instance, Surf Snowdonia is constructed on a formerly contaminated aluminum site that has been regenerated, repurposed, and revitalized into a healthy plot of land. It can now offer group adventures and education to the local community and visitors in the naturally vibrant surrounding environment. Welcomes 150,000 visitors, produces 30,000 waves, and stages the first ever major international surf event in a wave lagoon, the Red Bull Unleashed. Nowadays, it typically opens from March through October and attracts a very impressive 150,000 visitors to its remote location in North Wales.

In the other hand, there are also three facilities currently under construction, two in Brazil, one of which will open in May 2021, and another in Switzerland, which is expected to open to the public in May 2021. Finally, it currently has more than 40 projects under development around the world. Map showing Wavegarden's projects under development(Figure 2);



Figure 2. Wavegarden's projects under development

3. The core business model

The Computational Fluid Dynamic experts are key to Wavegarden's success. Performing simulations 24/7, all year long, they study the hydrodynamics of the machinery and analyze the effects of different lagoon bathymetries and dissipative shores on wave quality and form. Crucially, this cross-referencing and validation of computer simulations permits the continuous calibration of design tools. That is how the company can test the entire product development cycle "in house", before the products go to market, avoiding risks and errors.

Wavegarden also provides the complete range of engineering and business services that are required to ensure both the immediate and long-term success of a surf park. Wavegarden's team of experts accompanies clients from the inception of their project to well beyond their launch, sharing their expertise and experience throughout this exciting journey.

The services offered by the company are detailed below.

- **Site Analysis & Design Studies:** customized conceptual design studies provided with realistic computer-generated 3D renders and video animations of client's surfing facility. Following a market and location analysis, we explore and recommend the potential leisure activities that can be developed alongside the surfing lagoon.
- **Economic Feasibility Study:** in order to reduce project risk and help secure investors and permits, a robust business plan is needed that examines all aspects of the project, from concept and product mix through to visitor forecasts, financial projections, management and marketing.
- **Lagoon construction:** from the range of construction solutions developed by company's civil engineers for different terrain and water table conditions, Wavegarden will propose the option best suited to client's particular site.
- **Project Monitoring, Supply, Installation & Commissioning:** meticulous support is provided by expert project managers

to ensure proper coordination between all parties throughout the key phases: design, planning, civil work, installation, and commissioning.

- **Water Treatment:** this service helps determine the appropriate treatment solutions in line with local regulations, water treatment engineering supervision during project development and operation.
- **Lighting solutions:** we have implemented and tested systems at the demo center that deal with all aspects of light diffusion, reflection, and safety. Now the company is able to offer proven and cost-efficient LED lighting solutions that can be tailored for all facility sizes and conditions.
- **Maintenance solutions:** To create a successful surf destination, the machinery and operating systems must be in perfect running order and in compliance with all the relevant safety regulations. Wavegarden provides a combination of intelligent and preventive maintenance services to maximize the availability, efficiency and lifetime performance of the machinery. The Maintenance Support Package includes, remote monitoring 24/7, routine maintenance and training programs.

To ensure the optimum operation of the surfing lagoon and other related business units, Wavegarden also provides the following operational services:

- **Lagoon operation & safety:** support in the development and implementation of customized operational and safety procedures, as well as in the selection and training of lifeguards and staff.
- **Surf school business:** assistance in establishing a professional surf school, equipment selection and ordering of the right boards, development of operational procedures, high performance and junior training programs, staff selection and instruction.
- **Surf shop business:** guidance through the whole process, establishing key partnerships, selecting popular and

profitable products, placing first orders, and hiring the right team. Thanks to the terms pre-negotiated by Wavegarden with leading surf brands, facility owners benefit from special sales conditions and other advantages, such as free surf school products, event sponsorship, and inside access to high-profile athlete demo sessions.

- **Facility operation:** support in the creation to create an unforgettable surf experience for guests of every age and ability, while maximizing commercial revenues of the different operational units.
- **Events:** with perfect surf conditions guaranteed day and night, a firm running schedule, and excellent spectator and media viewing, the event possibilities at a Wavegarden are endless. The company offers support to plan and organize a single event or an annual program, from international surf contests and festivals to summer parties, family days, and corporate functions.

4. Ongoing research & development

The focus of the company has always been on optimizing the surfers experience while minimizing energy consumption. To achieve this, many different methods of producing waves have been tested to attain the simplest, most efficient, most reliable technologies possible.

4.1 Wavegarden Cove technology

The Wavegarden Cove is created with the world's most advanced and energy efficient technology for the generation of artificial waves for surfing and the development of world-class, commercially viable surf parks.

Wavegarden develops and manufactures state-of-the-art wave generation systems and surf lagoons with patented technologies

that offer maximum wave number, quality and variety, with the highest user capacity.

Success in the development of efficient wave generation systems is based on the ability to simulate wave behavior and the design of the different lagoon parameters in order to offer premium solutions for each customer. As mentioned, - thanks to test facilities fully dedicated to R&D - it is possible to test the technology and products before commercialization, thus ensuring a successful commercial deployment.

Wavegarden Cove technology is based on the construction of panels that move in harmonic sequence to produce perfect waves, while continuously injecting energy into them as they move forward. A unique feature of the Wavegarden Cove is that the wave shape and size can be easily adjusted by changing the wave type in the software control unit. In continuous mode, this technology allows to create up to 1000 waves per hour, which is 2 waves every 8 seconds, one left and one right on both sides of the central wall with a capacity for 88 surfers. This is an essential feature to develop an economically viable business while guaranteeing an authentic surfing experience for all ages and levels of surfers.

The following is a summary of the most significant features of this technology:

- **The best and most authentic surfing experience:** greater variety and frequency of waves. Easy-to-use control system that allows you to modify wave shape, frequency and size in real time.
- **Maximum wave frequency:** Between 300 and 600 waves per hour depending on wave configuration and operational requirements (maximum frequency c.1000 waves/hour).
- **Highest capacity:** up to 88 surfers simultaneously.
- **Long rides:** in standard size facilities, all surfers can enjoy rides up to 16 seconds long with the possibility of longer waves by adding more modules.

- **Patented electromechanical technology:** free of complicated hydraulic or pneumatic systems that are less efficient and require more maintenance.
- **Highest level of energy efficiency:** 10% less than equivalent sized systems using pneumatic technology.
- **Reliable and robust modular machinery:** 98% availability guarantees continuous operation. Repairs and maintenance can be performed during normal operation.
- **Customizable structure:** ability to do large or small projects.
- **Noise free:** Electric motors and machinery are virtually soundless; the only sound heard is the sound of breaking waves.
- **Crystal clear water:** Wavegarden's water treatment system is integrated into the surfing lagoon to deliver crystal clear and hygienically safe water.
- **Highest Business Viability:** Available for small and large footprints and fully customizable this innovative water sports facility built around surfing is a sound investment as a stand-alone or mixed-use development.

4.2 Water treatment system

Wavegarden has pioneered the man-made wave industry and is the only company to offer a water treatment system, which is designed and built specifically for surfing lagoons. This system is based on a series of sustainable treatments including fine filtration, ozone and UV disinfection, and minimal chlorination. It is the only system on the market capable of treating 25,000m³, while complying with swimming pool regulations.

5. The experience

With a clear vocation to develop a non-existent market, create an attractive, praiseworthy product that respects the environment and community needs, Wavegarden has been

developing leading-edge wave technologies to create the most realistic surfing experience available outside of the ocean. This is why Wavegarden won the hearts of the world's most renowned professional surfers, but also of those who have never surfed before. The company offers fun activity and a versatile training adaptable to any level. Here are some of the most outstanding testimonials:

“We’ve had an exciting start to the business with strong session occupancy since opening. The quality of the wave and capacity in the lagoon has delivered an amazing experience for our members and guests, which is key for the viability of the park. “

Damon Tudor, CEO of URBNSURF



Figure 3. Gabriel Medina, WSL World
Champion

“I think it's the most fun I ever had with my friends. I got so many waves, it's a good training, and my legs are burning right now.”

Gabriel Medina, WSL World Champion 2014+2018, Brazil



Figure 4. Rob Machado, Pro Surfer

“It’s amazing how much the wave can change and how diverse it is with all the different options. There are so many choices.”

Rob Machado, Pro Surfer

“I am thinking about the implications for competition... You can be right up front next to the breaking wave and see how impressive it is. It’s mind-blowing.”

Greg Cruse, CEO Surfing America

“It’s very, very secure for a beginner. And it’s perfect having this family interaction in the water - helping out, playing together, having fun, pure fun.”

Dr Priscilla Mailman, Mother.

6. About the company

Wavegarden’s mission is to develop the best possible wave generation systems, aiding the establishment of high-quality surfing destinations blessed with ideal and safe conditions.

To achieve this, the company created a proven and worldwide patented wave-generating technology that revolutionized the sport of surfing. Accompanied by astute investors, Wavegarden has been able to create new surf destinations, booming businesses and tourism ecosystems in

various parts of the world regardless of their proximity to the ocean.

Surfers of all levels, from newcomers to the top competitors in the world, have tested the waves in the full-scale facility and their feedback has been instrumental in the development process.

The headquarters of Wavegarden are based in the Basque Country near San Sebastián in northern Spain. With a growing team of 65 staff, Wavegarden has pioneered every aspect of the man-made wave sector with in-house expertise in fluid dynamics, engineering, water treatment, architecture, construction, real estate development, venue operations and marketing.