# ADVANCING CIRCULAR PRACTICES:

# CASE STUDIES FOR A SUSTAINABLE TENERIFE

## CIRCULAR INNOVATION BOOTCAMP 2024

**DECEMBER 2024**

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Thank you and best regards.
Participants of CIB 2024

Humboldt
Cosmos
Multiversity


tagua


WOOPTIX

# ABBREVIATIONS

| Abbreviation | Meaning |
|---|---|
| CAGR | Compound annual growth rate |
| CSR | Corporate social responsibility |
| CIB | Circular Innovation Bootcamp |
| ERDs | Energy Recovery Devices |
| EIC | European Innovation Council |
| GEF | Global Environment Facility |
| HVAC | Heating, ventilation, and air conditioning |
| HYCO | International Hydrodynamics Corporation |
| IAC | Instituto de Astrofísica de Canarias/Institute of Astrophysics of the Canary Islands |
| IUCN | International Union for Conservation of Nature |
| NGOs | Non-governmental organizations |
| PRO | Pressure retarded osmosis |
| REF | Regime of the Canary Islands |
| ROI | Return on Investment |
| RO | Reverse osmosis |
| SDGs | Sustainable Development Goals |
| WFPI | Wavefront Phase Imaging |
| ULL | University of La Laguna/Universidad de La Laguna |
| UNCTAD | United Nations Conference on Trade and Development |
| ZEC | Canary Islands Special Zone |

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# 1. SUMMARY

This report examines various options for the transition to a more sustainable model by analyzing five selected organizations: The analysis follows the RESTORE model, which classifies business practices into five stages - conventional, green, sustainable, restorative and regenerative - according to their environmental and social relevance. It turns out that the companies analyzed, although demonstrating a commitment to sustainability, find themselves operating in the Green and Sustainable phases, presenting substantial opportunities to increase their sustainability and move towards restorative and regenerative practices.

Key insights from individual cases reveal that IACTEC currently finds itself in the Green stage with limited integration of renewable energy and insufficient waste management strategies. TAGUA still has some challenges to overcome on the road to environmental sustainability, despite the company's central importance on a social level. Loro Parque, which is strongly committed to sustainability, is currently still in the sustainability phase, while Wooptix does not have a comprehensive strategy to achieve zero impact. PIECES VI, like the others, is working towards sustainability goals, but without having reached an advanced stage.

The report emphasizes collaboration between participants in a system, the importance of sharing insights and best practices. These needs are followed by recommended joint strategies that focus on investing in renewable energy sources, strengthening community engagement to address local environmental challenges, and implementing circular economy principles to minimize waste. These recommendations aim to foster economic and ecological harmony on the island by promoting a collective approach in Tenerife that integrates scientific innovation with responsible environmental management.

The final considerations emphasise that advancing to the next stages of the RESTORE model, and thus achieving ever higher degrees of sustainability, requires constant and progressive planning and action. Organisations must adopt a holistic approach that takes into account the environmental footprint, while promoting resilience and regeneration. In this way, they can make a significant contribution to a regenerative economy. The insights gained serve as a guide for organizations seeking to shift to sustainable practices while addressing the pressing environmental challenges arising from their activities and environment.

# 2. INTRODUCTION

*(Authors: Michelle Strom, Aaiyushi Baid, Beatriz Mafra, Bruno Magalhaes, Verena Schmid)*

## The Five Stages Toward Regenerative Economy

> *Nature! We are surrounded and embraced by her: powerless to separate ourselves from her, and powerless to penetrate beyond her. Without asking, or warning, she snatches us up into her circling dance, and whirls us on until we are tired, and drop from her arms. She is ever shaping new forms: what is, has never yet been; what has been, comes not again. Everything is new, and yet nought but the old*
>
> ***(Goethe, 1869)***

Goethe's timeless reflection on nature captures the essence of interconnectedness and renewal, themes that resonate deeply with the principles of a regenerative economy. A regenerative economy envisions an economic system that restores, renews, and sustains natural, social, and economic resources. Fullerton (2015) describes regenerative practices as creating resilient, self-renewing systems aligned with natural processes (pp. 40-43). Unlike traditional linear systems or even sustainability-focused practices, it aspires to achieve a net-positive impact, ensuring that human activities not only coexist with but actively enhance the ecosystems they are part of (cf. Andreucci et al., 2021, p. 15).

The RESTORE model provides a comprehensive framework for understanding this progression. It identifies five stages – Conventional, Green, Sustainable, Restorative, and Regenerative – that represent the evolution of an organization's environmental and social impact (cf. Howard et al., 2018, p. 7311). Each stage highlights distinct goals and practices, moving from negative environmental and social consequences toward a positive, net-beneficial impact (see Figure 1).

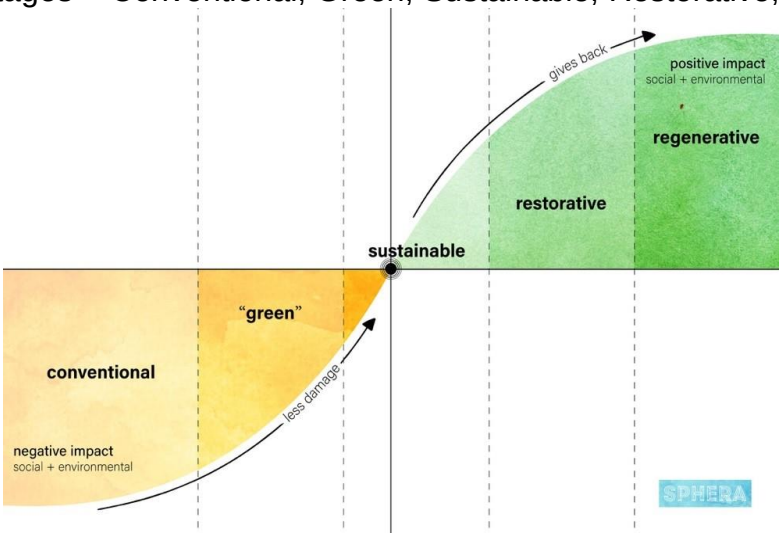


*Figure 1: The Restore Model (Sphera 2023)*

In the following, each stage of the RESTORE model and its significance in transitioning to a regenerative economy are explored:

The Conventional stage represents traditional business models that are characterized by negative environmental and social impacts (cf. Andreucci et al., 2021, p. 55). These models prioritize economic gain, often at the expense of resource sustainability and ecological balance. Industries in this stage typically rely heavily on fossil fuels, employ wasteful production methods, and show little regard for environmental or social consequences. Examples include activities that contribute to deforestation, resource overexploitation, and significant carbon emissions.

The Green stage marks an initial attempt to reduce harm through eco-friendly practices. Organizations at this level focus on minimizing their environmental footprint by implementing measures like energy efficiency and recycling programs (cf. Morseletto, 2020, p. 766f.). However, their efforts are largely aimed at damage limitation rather than achieving true sustainability. Examples of green practices include adopting renewable energy sources and reducing packaging waste, though these actions often fail to address broader systemic issues.

In the Sustainable stage, organizations strive for a neutral impact, seeking to balance resource consumption with conservation efforts (cf. Morseletto, 2020, p. 766f.). This stage emphasizes maintaining equilibrium, ensuring that operations neither degrade the environment nor provide substantial restorative benefits. Key features of this stage include carbon-neutral operations, equitable resource usage, and investments in sustainable infrastructure (cf. Andreucci et al. 2021, p. 59). For example, companies may offset their carbon emissions through renewable energy adoption or carbon credits.

The Restorative stage goes beyond sustainability by actively repairing environmental and social damage (cf. Morseletto, 2020, p. 767). Organizations in this stage focus on restoring ecosystems, enhancing biodiversity, and revitalizing communities. Examples include habitat restoration projects like reforestation, regenerative agriculture practices, and waste-to-energy initiatives. These efforts aim to address historical ecological footprints and establish stronger collaborations with local communities (cf. Andreucci et al., 2021, p. 50).

Finally, the Regenerative stage represents the highest level of environmental and social impact (cf. Morseletto, 2020, p. 768). At this level, organizations seek to leave a net-positive legacy, improving the natural and social systems they interact with. Regenerative practices integrate ecological and social considerations into their core operations, employing circular resource use and developing innovative solutions to enhance soil, water, and biodiversity. For instance, agroforestry systems that sequester carbon, improve biodiversity, and provide economic benefits exemplify this stage.

The RESTORE model offers a structured path for organizations to evolve toward a regenerative economy, demonstrating how businesses can balance economic, environmental, and social objectives (cf. Tomassini et al., 2022, p. 343).

## Structure of the Report

This report aims to present insights and recommendations that align with the principles of a regenerative economy. By addressing the challenges and opportunities presented by the participating companies IACTEC, TAGUA, Loro Parque, WOOPTIX and PISCES VI, the report explores actionable strategies to transition from conventional and green practices to restorative and regenerative approaches. The overarching objective is to provide Tenerife with a collective perspective for fostering economic and ecological harmony.

# 3. CASE STUDIES

## 3.1. Instituto de Astrofísica de Canarias (IACTEC)

*(Authors: Michelle Strom, Aaiyushi Baid, Beatriz Mafra, Bruno Magalhaes, Verena Schmid)*

### Company Overview

The Institute of Astrophysics of the Canary Islands (IAC) represents one of the most advanced and renowned scientific institutions in Spain, focusing on cutting-edge astrophysical research and innovation. At the core of its operations are activities that extend beyond merely advancing knowledge: IAC is actively involved in developing scientific instrumentation, managing observatories, and training future generations of researchers. Based in the Canary Islands, IAC is uniquely positioned geographically and academically to spearhead initiatives in sustainability and regenerative practices, which align with the emerging global priority of environmental restoration and social responsibility (cf. Instituto de Astrofísica de Canarias, n. d.). This case study evaluates IAC's current state in terms of its progress toward a regenerative economy. It explores its current challenges and opportunities and presents a roadmap for transformation.

### Current Status of the Company

According to the RESTORE model, IAC currently operates in the **green stage** of the regenerative economy (see Figure 1), as the institution has implemented measures to reduce its environmental footprint, but these efforts remain limited in scope and ambition. A key area of concern is **energy consumption**. As an astrophysics research institute, IAC relies on high-energy-consuming equipment such as telescopes, computing systems, and laboratory instruments. Although some energy-saving measures are in place, there is no comprehensive integration of renewable energy sources such as solar or wind power. The observatories, located in ecologically sensitive areas in Tenerife and La Palma, would particularly benefit from renewable energy systems, which could align the institution's operations with broader sustainability goals.

Another area where IAC's current practices highlight limitations is in **waste management**. While basic recycling programs are in place, they are insufficient to address the specific challenges posed by electronic and scientific waste generated by the institute. Outdated telescopes, computing hardware, and laboratory instruments are often discarded without comprehensive strategies to recover valuable materials or responsibly dispose of hazardous components. This presents a missed opportunity to align IAC's operations with the principles of a circular economy, which emphasizes the

reuse, refurbishment, and recycling of resources to minimize waste and environmental harm.

IAC's **community engagement** efforts are notable but not fully aligned with the principles of a regenerative economy. The institute conducts educational outreach programs and public events, which foster local interest in astrophysics and science more broadly. However, these initiatives are primarily focused on educational enrichment rather than ecological or social restoration. A regenerative approach would involve deeper collaboration with local communities to address pressing environmental challenges, such as habitat degradation or climate change impacts in the Canary Islands. This would allow IAC to leverage its scientific expertise to contribute meaningfully to regional ecological restoration efforts.

Despite these challenges, IAC demonstrates significant potential for advancing its sustainability and regeneration agenda. The institute's commitment to innovation and scientific excellence provides a strong foundation for adopting cutting-edge solutions in energy efficiency, waste management, and community engagement.

Notably, IAC has already expressed a strong interest in **investing in solar panels** as part of its efforts to reduce its reliance on non-renewable energy sources. Given the high solar potential of the Canary Islands, this initiative aligns with both the environmental goals of the region and the global transition toward renewable energy systems. The installation of solar panels would not only help IAC lower its carbon emissions but also serve as a long-term cost-saving measure, reducing energy expenses for its energy-intensive observatories and research facilities.

In addition to renewable energy investments, IAC is actively working on **digitalization** initiatives to modernize its operations and reduce waste. This includes transitioning administrative processes to paperless systems, digitizing observational data storage, and enhancing the efficiency of its internal workflows. These efforts reflect a forward-thinking approach that prioritizes sustainability while also improving productivity and accessibility. Digitalization is not only expected to reduce the environmental footprint of IAC's operations but also support its mission of scientific excellence by ensuring that resources are managed effectively, and innovations are implemented seamlessly.

By building on these ongoing initiatives and progressing through the stages of the RESTORE model, IAC can take a leading role in integrating sustainability into the scientific research sector. These steps will allow the institute to reduce its environmental impact, increase its operational resilience, and set a benchmark for how research institutions can contribute meaningfully to a regenerative economy.

## Research Focus

The Institute of Astrophysics of the Canary Islands is an institution that thrives at the intersection of scientific discovery and innovation, continually pushing the boundaries of astrophysics. However, in the face of growing environmental challenges and a global shift toward sustainability, IAC has recognized the need to align its operations with broader environmental and social goals. In this context, IAC posed a critical question: What steps can the institute take to progress toward a higher level of sustainability and eventually a regenerative economy?

This question reflects a growing awareness among research institutions worldwide that operational excellence cannot be divorced from environmental stewardship. Scientific organizations like IAC play a unique role in society—not only as drivers of technological progress but also as models for responsible innovation (cf. Shaffer 2019, p. 15). Their operations often demand significant energy, generate specialized forms of waste, and impact surrounding ecosystems. Thus, the need for transformative strategies that integrate environmental, economic, and social priorities has never been more pressing.

At the heart of IAC's inquiry lies a commitment to move beyond incremental improvements in sustainability. Rather than focusing solely on energy efficiency or waste minimization, the institute seeks to adopt a holistic approach that addresses its ecological footprint while fostering resilience and regeneration. This involves not just adopting green practices but advancing through the Sustainable, Restorative, and ultimately Regenerative stages of the RESTORE model.

IAC's challenge is both specific and systemic. As an institution with energy-intensive observatories and a significant reliance on cutting-edge technologies, it faces unique barriers to achieving sustainability. High-energy consumption from telescopes and data processing, the complexity of managing electronic and hazardous waste, and the need for community integration in its ecological initiatives all require tailored solutions. Moreover, as a prominent institution in the Canary Islands, IAC must also consider its local environmental context, including its impact on sensitive ecosystems and its role in supporting regional climate goals.

By framing its question within the RESTORE model, IAC acknowledges that the journey to a regenerative economy is not linear but requires deliberate planning and progressive action. The challenge is presented to address immediate operational inefficiencies while also setting long-term goals for ecological restoration and community engagement. It emphasizes how scientific expertise, and innovative approaches can be leveraged to create systems that are not just sustainable but actively regenerative.

## Data and Results

This chapter seeks to answer IAC's call for circular innovation. To guide the Institute of Astrophysics of the Canary Islands toward a regenerative economy, a structured roadmap rooted in the principles of circular and regenerative practices is essential. Based on the identified challenges and opportunities in IAC's operations, this roadmap outlines how IAC can integrate circular practices into its core activities.

The establishment of a sustainability-oriented mindset is imperative for the integration of circular economy principles within the operational framework of IAC. This cultural transformation guarantees that sustainability is recognized as a fundamental value, influencing every dimension of the organization's activities and decision-making processes. By promoting a mindset centered on sustainability, IAC can secure long-term environmental stewardship, mitigate resource utilization, and optimize operational efficiency across all its initiatives.

The cornerstone of this mindset is rooted in comprehensive education and heightened awareness. The implementation of regular workshops facilitated by subject matter experts on themes such as energy efficiency, waste minimization, and circular economy methodologies can equip personnel with the requisite knowledge and instruments essential for making sustainable choices in their routine responsibilities.

Over time, the promotion of a sustainability mindset yields a plethora of advantages. Internally, it bolsters employee morale, encourages collaboration, and enhances staff retention, as individuals perceive their contributions as part of a significant mission (cf. Rimanoczy, 2019, p. 22). Externally, IAC's stature as an innovative institution is augmented, thereby attracting skilled individuals and fostering strategic partnerships. On a broader scale, this positioning establishes IAC as a paradigm for other scientific entities, catalyzing a wider transition towards sustainable practices in research. By embedding sustainability within its organizational ethos, IAC can assure its ongoing success while making a constructive impact on the planet's ecological trajectory.

**Resource Optimization:** constitutes a fundamental principle of the circular economy and represents an urgent requirement for IAC. Observatories necessitate considerable energy resources to facilitate telescope operations, data storage, and the upkeep of controlled environments such as cleanrooms. Furthermore, the extensive volume of data produced by astrophysical research exerts tremendous strain on computational resources. The implementation of strategies aimed at optimizing resource utilization and minimizing waste is not only advantageous for sustainability but also imperative for achieving cost-efficiency since Astrophysics equipment's cost more than millions of dollars with a maximum of 15 years of lifespan.

**Repurposing Obsolete Equipment:** A practical method involves the repurposing of obsolete equipment. Astrophysical instruments, even when deemed unsuitable for forefront research, frequently possess substantial functional value. For example, decommissioned telescope mirrors can be meticulously polished and refurbished for educational initiatives, such as hands-on astronomy workshops designed for students.

Likewise, sensors and spectrometers that no longer fulfill the precision standards required for professional research can be repurposed for outreach activities, thereby engaging the public in the marvels of astronomy. Furthermore, IAC can engage in partnerships with educational institutions, including schools and universities, to either donate or loan outdated computing systems and instruments, thereby ensuring that these resources continue to fulfill educational objectives.

**Cleanroom Efficiency:** Cleanrooms, which are pivotal for the assembly and maintenance of delicate astronomical instruments, represent considerable energy consumers. These specialized environments necessitate stringent control of temperature, humidity, and particulate matter, resulting in elevated energy requirements. To mitigate their ecological impact, IAC may adopt a variety of strategies:

Enhancing HVAC systems through the integration of energy-efficient models that are capable of adjusting to fluctuating workloads. Utilizing renewable energy sources, such as photovoltaic solar panels, to supply power to cleanroom facilities. Implementing sophisticated filtration systems that necessitate fewer replacements, thereby minimizing waste generation.

**Circular Reuse of Old Machines:** IAC has the opportunity to implement circular economy principles by repurposing old telescopes and equipment for educational purposes. The circular economy framework can be succinctly understood through the 3R model: Reduce, Reuse, recycle (see Figure 2).


*Figure 2: Circular Economy R-Strategies Chart (Recapp, 2024)*

This model highlights key strategies for minimizing waste and maximizing resource efficiency. Since the regulations prohibit the company the sale of decommissioned machinery, the instruments can be refurbished and used in outreach programs. For example, outdated telescopes could be adapted for use in student workshops or public astronomy events, which might encourage interest in astrophysics while extending the lifecycle of valuable resources. Additionally, components like sensors or computing systems that no longer meet research standards could be donated or loaned to schools and universities for teaching purposes. This approach aligns with IAC's mission of education and public engagement while reducing waste and demonstrating leadership in sustainable science practices. That means that by embedding the 3R principles into its operations, IAC not only reduces its ecological footprint but also fulfils its practices with the broader goals of the circular economy.

**Digital Transformation:** The mitigation of paper consumption represents a critical dimension of resource optimization. Although IAC has initiated preliminary measures to monitor paper utilization, a more holistic strategy necessitates the digitization of all administrative and research-related workflows. The implementation of cloud-based collaborative platforms, electronic signatures, and digital documentation systems can

substantially diminish the reliance on printed materials. Furthermore, enhancing employee awareness regarding the advantages of digital tools and establishing departmental objectives for paper reduction can further facilitate this transition.

The ramifications of these initiatives are complex and multifaceted. From a fiscal standpoint, the reduction of energy consumption within cleanroom environments and the reuse of equipment lead to lowered operational expenditures, thereby permitting a greater allocation of resources toward research endeavors. Environmentally, the optimization of resource utilization diminishes the carbon footprint of IAC and ensures that the institution is aligned with international sustainability benchmarks. Lastly, the repurposing of equipment and the reduction of waste contribute to prolonging the lifecycle of essential resources, thereby underscoring IAC’s dedication to responsible stewardship.

**Collaborating with local environmental organizations**, including Fundación para el Desarrollo Sostenible and Terramare, enables IAC to augment its sustainability initiatives and actively engage with the surrounding community. Collaborative endeavors such as reforestation initiatives and coastal cleanup operations can effectively tackle urgent ecological challenges, including deforestation and marine pollution, whilst also facilitating environmental rehabilitation. These alliances additionally afford IAC opportunities to implement community outreach initiatives, thereby enhancing public consciousness regarding sustainability through workshops, events, and educational campaigns.

This methodology helps to reduce the gap between empirical research and the general population, thus increasing IAC's stature as a conscientious institution dedicated to scientific and environmental advancement, demonstrating that the institute is not only interested in technological advances, but also in engaging with social causes and improving society's quality of life.

Moreover, collaboration with environmental organizations promotes the interchange of knowledge and resources, thereby engendering innovative solutions to sustainability dilemmas. Such collaborations can also unveil funding prospects from governmental entities and various agencies that advocate for environmental initiatives. By obtaining grants for collaborative projects, IAC can underwrite larger-scale sustainability endeavors, such as renewable energy initiatives or biodiversity conservation efforts. In summary, these partnerships amplify IAC’s influence, contributing to both scientific progress and environmental stewardship, whilst establishing a paradigm for other institutions to emulate.

Finally, this initiative also contributes to a change in mentality within the institute, as employees come to understand the importance and benefits of effectively applying sustainable ideas, creating an environment conducive to even greater progress.

The implementation of **educational initiatives** centered on circular economy principles and sustainability represents a formidable strategy for IAC to engage with the surrounding community while nurturing a future cohort of environmentally aware

professionals. By specifically targeting local educational institutions, including the University of La Laguna (ULL), IAC can present a diverse array of workshops, lectures, and experiential learning activities designed to familiarize students with the tenets of sustainable science, notably the circular economy. These initiatives could encompass interactive demonstrations, informative presentations delivered by IAC researchers, and project-oriented learning exercises wherein students devise their own sustainable innovations pertinent to fields such as astrophysics and environmental conservation. Moreover, students could partake in authentic projects, such as exploring renewable energy alternatives for observatories or assessing the ramifications of light pollution, thereby establishing a tangible connection between the domains of space science and environmental sustainability.

The benefits of these educational initiatives are numerous. Primarily, they enhance IAC's appeal as a prospective employer for emerging talent, facilitating early engagement with individuals who may aspire to join the institution post-graduation. Additionally, these programs contribute to the enhancement of the institute’s societal reputation by directly impacting the education and professional development of the forthcoming generation of scientists, thereby cultivating a deeper sense of community involvement. Furthermore, by stimulating interest in sustainable science, these initiatives can augment public consciousness regarding the scientific endeavors of IAC, potentially leading to amplified support and funding for subsequent research initiatives.

The organization of an **annual competition** dedicated to the incorporation of innovative sustainable solutions within the realm of astrophysics represents a significant mechanism through which the International Astronomical Congress can engage a global talent pool, stimulate creative thought, and expedite the advancement of environmentally sustainable technologies pertinent to the discipline. This competition would solicit proposals from students globally, encouraging them to devise sustainable strategies to address the challenges encountered in astrophysical research and the operations of observatories. Such an initiative would not merely incentivize students to implement principles of the circular economy but would also facilitate international collaboration, as participants from a variety of backgrounds contribute distinct perspectives and innovative ideas. The individual or team deemed victorious would be awarded a monetary prize and attain public acknowledgment for their viable solution, which could subsequently be highlighted at scientific gatherings or potentially adopted by IAC. This acknowledgment would represent both a pivotal career achievement for the recipient and a strategic avenue for IAC to integrate state-of-the-art, sustainable solutions into its operations. Furthermore, the competition would elevate the profile of IAC as a pioneer in sustainable innovation, thereby attracting talented young individuals and prospective collaborators. Additionally, it has the potential to produce tangible, pragmatic solutions that improve the efficiency and sustainability of the institute's operations, ultimately benefiting both the infrastructure of IAC and the broader global scientific community.

## Discussion and Next Steps

The Institute of Astrophysics of the Canary Islands stands at a pivotal moment in its journey toward sustainability and regeneration. As a globally recognized leader in astrophysical research, the institute has the opportunity to lead by example in integrating circular economy principles into its operations. By addressing its energy consumption, waste management practices, and community engagement efforts, IAC can transition from its current position in the “Green stage” of the RESTORE model toward a regenerative economy.

This roadmap not only outlines actionable steps for IAC but also serves as a broader template for other research institutions striving to balance scientific excellence with environmental stewardship. By embracing circular and regenerative practices, IAC can achieve long-term resilience, reduce its ecological footprint, and set a benchmark for sustainable operations in the scientific community. Ultimately, the institute has the potential to inspire a global shift, demonstrating that cutting-edge research and sustainability are not mutually exclusive but mutually reinforcing.

## 3.2. TAGUA

### Company Overview

*(Author: Sophi Shcherbakova)*

Tenerife is one of the Canary Islands that faces the most significant water resource challenges. Since the island has no rivers, frequent rainfall, or other natural water resources besides ocean water, efficient water use, and management are crucial for sustainable development.

This report explores Tagua's role in water resource management. It discusses the company's approaches to water treatment, filtration, and distribution and highlights how it ensures the use of its technological resources and investments.

The water crisis in Tenerife is caused by its climatic and geographical conditions. The lack of natural drinking water and access to potable water make water management a significant challenge for Tenerife, and it plays a crucial role. Population growth and tourism have had a significant impact on the available resources.

- **TAGUA: A Pioneer in Integral Water Management**

Tagua has 30 years of experience in water management; the company serves various businesses, such as hotels and banana plantations, to provide them with filtered water for various uses. They are mainly engaged in the supply and installation of equipment. TAGUA's contributions are rooted in its professional expertise, commitment to innovation, and focus on environmental stewardship. (Tagua (2022, September 8). Tagua. Tagua.es. Retrieved November 26, 2024, from https://tagua.es/)

- **Comprehensive Solutions Across the Water Cycle**

TAGUA's interventions span every stage of the water cycle. The company excels in identifying and extracting deep underground water resources and desalinating seawater to meet urban, agricultural, and industrial demands. Water treatment plants purify water to become drinkable water, and distribution systems are responsible for delivering it efficiently.

In more detail, a water filtration system extracts water from the ocean; then this water is delivered to a place where the equipment is installed, and the water is filtered through membranes. Of this, 40% is clean water used for drinking or irrigation, and 60% is waste returned to the ocean. Similar techniques are installed; for example, tap water becomes completely safe to drink with its help, and hotels also use it for golf courses. The company is also engaged in post-installation services, such as periodically checking water quality or providing assistance in case of leaks.

TAGUA's success is based on the use and maintenance of modern technologies in the water network, such as advanced leak detection techniques and Telemanagement tools. These highly innovative technologies and approaches improve the efficient use

of water and reduce losses. For example, TAGUA uses the latest inspection and maintenance techniques to identify and resolve bottlenecks in water delivery. The company implements practices promoting sustainable development, including efficient water reuse, which means that after filtering, wastewater is returned to the ocean, low-energy impermeability methods, and precision irrigation techniques for agriculture.

Beyond environmental goals, TAGUA prioritizes health and safety, workforce development, and community engagement. By implementing innovation and teamwork in taguas company culture, the company ensures the career growth of its employees, taking into account the needs of its clients and society.

TAGUA's work helps alleviate the challenge of water scarcity. Desalination plants supply water for urban use, agriculture, and tourism, providing the island with a foundation and resources for its economic pillars. Pre-adapted technical plans guarantee high levels of quality, while advanced wastewater treatment technologies demonstrate water reuse, environmental impact reduction, and resource efficiency.

Furthermore, TAGUA empowers communities with water management techniques and technical support. For example, focusing on precision irrigation in agriculture has helped farmers reduce wastewater costs and increase crop yields, contributing to the island's food security and economic sustainability.

TAGUA demonstrates how technological innovation, expertise, and a commitment to sustainability can solve complex water challenges. By combining advanced technologies with a customer-centric strategy, TAGUA enhances water access and delivers long-term social and environmental benefits for the island.

- **Competitors**

Tagua operates in the water management sector in the islad of Tenerife, competing with leading players on market such as Aqualia and Teidagua.

Aqualia is a leading provider that manages water services in significant municipalities such as Guimarães, Candelaria, and Arrafó. With decades of experience, Aqualia secures long-term contracts and invests heavily in infrastructure renewal and technological advancements. Aqualia is an essential competitor for Tagua with its municipal network and scale.
Another major player in the market is the company Teidagua, which focuses on efficient water management and treatment. The company serves both the residential and commercial sectors. It effectively manages to optimize and maintain water resources in line with modern environmental goals and regulations. Both competitors will challenge Tagua with their established reputation, large-scale operations, and innovative approaches.

Tagua can stand out in the market if it focuses on local knowledge and service excellence. By highlighting its innovative water technologies that meet the needs of the Tenerife islands, Tagua can stand out from its competitors on market. Building strong networks and demonstrating sustanble practices, it can maintain its position in the market and develop in a competitive market.

## Current Status of the Company

*(Author: Jose Prada)*

Tagua has shown significant results in resource regeneration, especially through the use of desalination and wastewater reuse technologies. That said, the challenge to be faced is to reduce dependence on the most commonly used energy sources, which generate a significant environmental impact and high costs. Renewable energy sources, such as solar and wind power, can increase efficiency. In addition, the company uses advanced technologies for monitoring and controlling water quality, although there is still room to explore tools such as artificial intelligence and big data analysis, which could optimize processes.

The company in question also stands out for its operational resilience, taking into account the water needs of the population and the local production sector. However, the costs related to desalination could be revised if measures were adopted to use renewable energy. A relevant strategy would be to diversify the company's revenues by offering specialized water management services to other regions. The company could also consolidate its role as a sustainable agent in Tenerife, promoting sustainable practices aligned with the Sustainable Development Goals (SDGs). Academic partnerships, such as the collaboration with the University of La Laguna, reinforce its ability to promote innovations in the sector, which is already happening.

In terms of efficiency, TAGUA can also improve aspects at an operational level, such as reducing losses in water distribution. Real-time loss detection technologies and more durable materials in infrastructure are a promising area for future investment, thus reducing costs. The company has good relationships with local communities, public authorities and customers, but it will be important to increase transparency about the sustainable practices adopted, reinforcing public trust in general.

Finally, TAGUA has worked to train stakeholders in sustainable water management, but it can still expand its initiatives. Public-private partnerships and research programs are processes that can increase the impact on the sector. By adopting innovative technologies, strengthening relationships and focusing on energy efficiency, the company can not only maintain its position as a leader in water management in the Canary Islands, but also serve as a model for other regions.

TAGUA’s analysis under the RESTORE model stands out with sustainability principles, but as already mentioned, there are areas where there is room for significant improvement. The model in question reaffirms the importance of tools such as RESTORE in the transition to more sustainable business practices and integrated into the circular economy. TAGUA seeks to demonstrate how innovation and collaboration can address sustainable challenges, promoting positive social and environmental impact.

## Research Focus

*(Author: Hasan Mohammad)*

TAGUA is facing different kinds of challenges in implementing a sustainable and circular economy model in the water desalination business. It is necessary to face these challenges to minimize their impact on the environment and achieve global sustainability goals. Some challenges that need to be paid more attention to are given below:

- **Brine Disposal Challenge and Circular Economy**

During the water desalination process, TAGUA relies on reverse osmosis, which generates a huge amount of brine with different metals and concentrated salt solution. TAGUA uses membranes that cost nearly 400 euros per. Every year they get numerous numbers of membranes after water desalination. Most of the time these membranes are disposed of into the ocean or ground or left nothing. Because TAGUA does not have any technology to mine these membranes at present. Moreover, their left membranes are affecting the marine ecosystems of Tenerife. To be sustainable, TAGUA wants to apply “Brine Mining” technologies where they can extract some rare metals and minerals like magnesium and calcium from the brine. TAGUA wants to reuse the used membranes for mine extracting and selling those minerals to industries how they will create a financial benefit as well as it will help TAGUA to reduce the costs of membranes. However, TAGUA is facing challenges in finding the membranes extracting technologies on their own or in collaboration with other companies in market readiness. (Cristina Hurtado Tripiana, Earth. Org, 2024).

- **Dust- Resistant solar panel challenge**

Currently, TAGUA’s pattern of using energy for the desalination process left a significant carbon footprint in nature. Moreover, it is costly. To minimize cost and carbon footprint TAGUA can introduce their energy sources like solar, sea wave, or wind power. But the problem is “CALIMA”, a too much dusty wind from the desert Sahara of the African continent. Tenerife is very close to the Sahara Desert thus it faces a dusty wind every time. Because of this “CALIMA” solar panels are covered with dust and can’t produce enough energy for the Pumps. Moreover, wind turbines can’t be installed anywhere because of the law, and the hardness of soil. Additionally, a wind turbine needs huge space which TAGUA can’t manage. Getting energy 24/7 from renewable sources needs investment and upgradation of grid lines, which would be a good barrier for TAGUA to achieve global sustainability goals.

- **Wastewater Reuse Challenge**

The whole world is trying to introduce the potentiality of water reuse because of strong water scarcity. TAGUA wants to focus on advanced wastewater treatment to desalinate or produce water for agricultural, industrial, and even entertainment purposes like golf courses. Moreover, TAGUA knows these processes will contribute to sustainability by reducing surface water demand and environmental balance and pollution. (Gude, V. G. Vol. 16, Issue 4, pp. 591–609, 2017). But the Psychology of mass people is creating a barrier to reuse wastewater. They are facing challenges to bring changes in customer minds and reuse of wastewater.

## Results and Recommendations

*(Author: Irene Sabia)*

From primary data collected during the kick-off meeting, it was possible to grasp that the company focuses its activities and core competencies in water desalination. As of today the former activity represents 80% of their business while the management of wastewater has a minor relevance, accounting for 20%. (L.Sosa, personal communication, 2024) For this reason, in other to magnify the impact of the recommended actions in the most effective way, the focus of the analysis was centered on the water desalinization industry.

**Desalinization industry**

Despite water covering 71% of Earth's surface, water scarcity is a growing global challenge. (NASA, n.d.) Of the total water available on our planet, almost 97% is saline and only 0.5% is directly accessible for human consumption. Freshwater is essential for a healthy human life, but according to International Water Management Institute, 1.2 billion people lack access to water and according to the Wildlife Federation, two-thirds of the world's population may face water shortages by 2025 (Straits Research, 2023). The limited availability of freshwater resources underlines a critical imbalance in water distribution. The challenge is exacerbated by the growing population, industrialization and climate change that deplete surface and groundwater sources faster than natural replenishment. (Gude, 2017).

Several geographical regions face significant challenges related to water scarcity, both physical and economic. Areas particularly affected are Sub-Saharan Africa, parts of Asia and the Middle East. Key factors contributing to this problem include prolonged droughts, excessive water consumption, contamination of water sources and geopolitical tensions. (Omerspahic et al., 2022a) Exacerbating this shortage is the intensive exploitation of resources for agricultural, industrial and domestic purposes. While geographical and political obstacles prevent a fair distribution of resources to the disadvantage of underdeveloped areas. (Pramanik, Shu and Jegatheesan, 2017) These factors combined will lead to significant growth of the desalination market and its establishment as an essential industry. The industry, whose market valuation was estimated at USD20.32 billion in 2023, is expected to grow at a cumulative annual growth rate (CAGR) of 9.12%, reaching a value of USD44.57billion by 2032, in just nine years. (Straits Research, 2023)

Of the most affected territories mentioned above, Africa and the Middle East will represent the largest market for desalination, with rapid urbanization in the area and increasing tourism adding pressure on existing resources. (Straits Research, 2023) While the latter represents the largest slice of volume, the Asia Pacific region is the fastest growing, anticipating exhibiting a CAGR of 9.92% over the forecast period. Asian countries such as China, India and Japan are focusing on large investments in infrastructure to meet urban and industrial needs, supported by governments that are promoting water quality and wastewater treatment. (Straits Research, 2023)

In water desalination, reverse osmosis (RO) membrane technology has gained popularity due to technological advances that have improved the efficiency and accessibility of desalination systems. (Omerspahic et al., 2022) The continuous evolution of desalination technologies has proven their importance as central strategies for global water supply. The advances in energy-efficient systems achieved, and those yet to be achieved, have enabled and will further enable their scalability and sustainability and will be central to facilitate the supply of water to all generations to come who will need it more and more. (Gude, 2017)

**Environmental issues**

The centrality of the desalinization industry is clear, nonetheless there are concerns regarding the adverse environmental impacts associated with it.

The major environmental issues can be classified in brine management and discharge; greenhouse emissions; intensive energy use; noise pollution and damage of marine ecosystem. (Williams, no date a; Tularam and Ilahee, 2007; Ihsanullah et al., 2021)

These issues stem from specific operational causes. The waste product of desalinization is brine, a highly concentrated saline solution that can reach up to twice the salinity of seawater and may contain potentially harmful chemicals. (Pramanik, Shu and Jegatheesan, 2017) The brine at the end of the process is discharged into the ocean at a superior temperature and pressure. When it reaches seawater, it increases local salinity level and reduces the oxygen concentration, potentially harming marine life. Moreover, the presence of chemicals in the solution, such as chlorine and copper, further increases the hazard for the ecosystem. (Zayat, Nasr and Sewilam, no date, Omerspahic et al., 2022a) The major responsible of the greenhouse gas emissions associated with the process is the high energy input required, primary sourced by fossil fuels. The combustion of the latter releases pollutants, affecting air quality, human health and environmental stability.(Williams, no date a) Moreover, the machinery used in the desalination plants generates significant noise pollution that can reach a maximum of 70- 80 dB(A)(Ihsanullah et al., 2021) (N.Martinez, personal communication, 13 November, 2024).

- **Brine management and discharge**

As mentioned above, the desalinization process generates a consistent amount of brine, that needs to be disposed of. Currently there are five main disposal options: surface water discharge, deep well injection, land application, evaporation ponds and conventional crystallizers. The disposal choice should be carefully evaluated since its cost will varies from 5% to 33% of the total process. (Pramanik, Shu and Jegatheesan, 2017) Multiples are the factors affecting the cost component, such as the characteristics of the brine, the level of treatment before disposal, the volume and the selected disposal option. (Pramanik, Shu and Jegatheesan, 2017)

**A) Conventional practices**

- ***Surface water discharge***

Surface water discharge involves the transportation of the brine to the discharge site, construction and operation of the outfall and monitoring. This disposal option is the least capital intensive among the five. The discharge site could be different water sources, such as lakes, rivers, seas or lagoons. As mentioned in the environmental impacts of the industry, there are serious concerns about the contamination of the receiving waters. Different mitigation strategies that try to reduce the salinity before the discharge are under analysis however the long-term impact of the effect of high salinity and temperature remains uncertain. (Pramanik, Shu and Jegatheesan, 2017)

- ***Deep well injection***

Deep well injection allows the brine to dispose of the brine by injecting it into a deep aquifer situated under the groundwater layers. The aim of the injection in such a depth is to prevent the movement of the waste into sources of drinking water. Hence specific geological conditions need to be met. The site chosen must have the capacity to capture the brine for the whole life of the desalinization plant and must be hydraulically isolated. Because of the issues associated with the site selection, corrosion and risk of leakages, the costs associated with the options are substantial and it is usually selected in absence of other solutions. (Pramanik, Shu and Jegatheesan, 2017)

- ***Land application***

Land application allows the reuse of the brine blended with freshwater for irrigation. Such an option could provide beneficial use when nutrients are needed. However, there are numerous factors influencing its feasibility: land availability, dilution costs, salinity tolerance of the vegetation, and soil requirement. (Pramanik, Shu and Jegatheesan, 2017)

- ***Evaporation pond***

Evaporation ponds are a simple, low-maintenance and low-cost solution for brine disposal. The brine is brought into large ponds where it is left to evaporate by the heat of the sun, leaving only salt. (Pramanik, Shu and Jegatheesan, 2017) This method is mainly used in regions where there is a lot of solar energy and therefore high evaporation rates, but also where there are large available spaces due to the great need for land. Proper design and maintenance are necessary so that the risks associated with soil and groundwater pollution are minimized. (Pramanik, Shu and Jegatheesan, 2017)

- ***Conventional crystallizers***

Conventional crystallizers allow the recovery of metals and salts from the concentrate as well as their disposal. The method used uses the crystallizer to separate the salts from the concentrate. (Pramanik, Shu and Jegatheesan, 2017) This method is certainly more expensive than the others and involves more practices, such as mixing with sea

water, evaporation tanks and further industrial processing to obtain useful salts. There are studies showing that it is possible to obtain substances useful especially to the chemical industry such as magnesium hydroxide, sodium chloride but also calcium carbonate and sodium sulphate. (Pramanik, Shu and Jegatheesan, 2017)

**B) Emerging technologies**

Brine treatment allows the recovery of valuable materials such as cesium, rubidium and lithium as well as salts. Current technologies do not allow the materials to be extracted at a high purity and require further improvements. (Pramanik, Shu and Jegatheesan, 2017) Other fields explore the improvement of membrane technologies to recover resources and make the process more efficient, but also the production of energy and its use for agriculture and aquaculture. (Pramanik, Shu and Jegatheesan, 2017)

- ***Pressure Retarder Osmosis***

Thanks to the Pressure Retarded Osmosis (PRO) process, it is possible to exploit salinity gradients to generate energy. The process involves separating a high-salinity solution, such as seawater, and a low-salinity solution, such as river water, by a semi-permeable membrane. Chemically, this will cause the water to flow true to the saltier solution to balance. This displacement slowed down by pressure applied to the side of the salty solution will allow mechanical energy to be generated. (Kim and Elimelech, 2013)

The process was tested using fresh water and seawater as factors. The results were limited because the current technology proved that the membranes do not perform well enough to generate high power with traditional salinity gradients. Experimentally, brines from desalination plants have been used as highly saline solutions. The latter, having much higher concentrations than seawater, create stronger salinity gradients. One configuration involves opposing the brines with seawater. This would make the process simpler, eliminating the need to separate water streams, and much cheaper. Positive experiments have been conducted in the laboratory, resulting in an output of 4.7W/ m² at a temperature of 30°C. (Kim and Elimelech, 2013) The main obstacle for PRO as a renewable energy source nowadays is the membrane itself. In general, however, it can be said that PRO has significant potential as a renewable energy source, although it requires further development and research to become a viable technology on a large scale. (Kim and Elimelech, 2013b)

- ***Aquaculture and sustainable agriculture***

Several studies have analyzed the possible reuse of brine to turn it into a productive resource. Oron et al. developed a model that has great potential for arid areas and would be able to foster greater economic and environmental sustainability.

The approach takes place in three different phases. The project began with the cultivation of duckweed, a high-protein floating plant. Such a plant grows in salt water by absorbing nutrients such as ammonium and nitrates and thus improving the quality

of the water itself. The plant is also often used as fish food, that comes in handy for the second phase. (Oron, Appelbaum and Guy, 2023) In fact, the second phase involves the breeding of fish (tilapia) that are particularly tolerant of brackish water. Finally, the water from the appropriately controlled reservoirs is used to irrigate plants particularly salt tolerant called halophytes, such as Salicornia. (Oron, Appelbaum and Guy, 2023)

This study is not the only one of its kind and the potential reuse of brine for aquaculture and agriculture is being analyzed by numerous researchers. Sánchez et al. designed their Project in arid areas of Brazil by combining fish farming with the cultivation of Atriplex nummularia and Spirulina. The brackish wastewater is used to breed tilapia (Oreochromis sp.), a species resistant to high salinity. The results show an average production of 648 kg of fish per 330 $m^3$ pond in about 150 days, with a survival rate of 94%. Once again, residual water from the fishpond, enriched with organic matter (manure), is used to irrigate fields of Atriplex nummularia, a halophyte that tolerates high salinities (up to 31.2 mS/cm). (Sánchez, Nogueira and Kalid, 2015)

These shrubs provide fodder for local livestock. A third option is also presented, the production of Spirulina cyanobacteria as an alternative to fish farming for evaporation ponds. The microalgae offer sustainable protein production with tolerance to extreme saline environments and high market potential (USD 20/kg dry bulk).(Sánchez, Nogueira and Kalid, 2015) While the literature highlights the economic and environmental benefits, it should be noted that prolonged irrigation with brine could lead to progressive soil salinization, so more research is needed in the field.(Sánchez, Nogueira and Kalid, 2015)

- ***Greenhouse emissions***

The desalination industry's contribution to total greenhouse gas emissions comes mainly from the energy-intensive use of energy required in the process that leads to obtaining fresh water. Modern technologies, such as reverse osmosis and distillation, require a significant amount of energy, which is most often obtained through the use of fossil sources leading to a significant carbon footprint. (Ihsanullah et al., 2021)

- **Intensive energy use**

The large energy input required to operate the plants is one of the major disadvantages, which is also partly the cause of the above. The energy required for pumping and treating water contributes to higher operating costs but also to the overall increase in energy demand. (Gude, 2017)

- **Noise pollution**

The noise pollution generated is substantial and can have negative effects on local communities but also on surrounding ecosystems. The source of this noise pollution are engines and pumps, which are key elements of the current process. The noise and vibrations produced, as well as creating discomfort to neighboring homes and communities, can affect the behavior of aquatic organisms.(Zayat, Nasr and Sewilam, no date)

- **Damage of marine ecosystem**

The impacts on marine life are related to three factors, two of which, frost management and noise, mentioned above. The third factor is related to the withdrawal of large volumes of water, the starting point of the desalination process. In the withdrawal, it is possible that micro-organisms, plankton and small algae, together with micro rocks are removed. The constant withdrawal of large volumes in a specific and delimited geographical area combined with the previous two factors can lead to the alteration of marine life, the loss of biodiversity and the impairment of local food chains. (Williams, no date, Zayat, Nasr and Sewilam, no date a, Tularam and Ilahee, 2007; Sánchez, Nogueira and Kalid, 2015; Gude, 2017; Ihsanullah et al., 2021; Omerspahic et al., 2022a, Oron, Appelbaum and Guy, 2023)

**Recommendations**

*(Author: Irene Sabia)*

From the research conducted and the data obtained, several directions were identified that can increase the sustainability of the business by partly changing its business model. The approaches proposed below aim to benefit current communities while preserving the well-being of future generations.

Five areas of significant impact have been identified in the desalination industry. Discussions with company representatives made clear their awareness of the urgent need to switch to renewable energy sources. Such a shift would significantly reduce the industry's environmental footprint.

The visit to the sewage treatment plants, which took place in the south of the island, was an opportunity to confirm the increasing attention but also the adoption of measures in this area. in fact, the “Comunidad de Regantes Las Galletas” will initiate a project in 2025, in collaboration with the European Union, to power their industries and desalination facilities entirely with renewable energy sources.

The presence of positive developments in this regard led our analysis to focus on different considerations in the three following areas of improvement: brine management, marine environmental damage, and greenhouse gas emissions. The suggested measures combine large-scale investments with high-impact potential a smaller, low-effort initiatives for quick wins. The plan was structured to align environmental objectives with economic viability, ensuring a comprehensive and actionable framework for advancing sustainability in the desalination sector.

Hence the measures and the related considerations have been organized into different time dimensions:short, medium, and long term.

- **Short term (1-3 years)**

*(Author: Irene Sabia)*

Analyzing the competitors' main available source of communication, their website, a different communication strategy emerged. Multinationals like Suez, Aqualia and

Veolia press for communicating social responsibility and community engagement, trying to emphasize the positive impact of their work as much as possible. The latter founds scientific argument in support. Smith and Jones (2020) suggest that web marketing on corporate social responsibility can increase firms' performance and brand image among stakeholders. Tagua should consider redesigning its website, simplifying navigation and highlighting its corporate social responsibility (CSR). This approach would not only improve the user experience, making it easier for visitors to find relevant information, but as just mentioned would also increase site traffic and improve the company image. Furthermore, it should be pointed out that Tagua currently bases most its advertising on word of mouth and customer satisfaction. To be true to the corporate identity and their values, adding sections dedicated to customer reviews would strengthen the brand. In addition, publicizing the support and satisfaction of internationally renowned hotels, such as the Ritz, could help increase the trust and willingness of future customers.

The new website will be crucial in the second action of the plan. In fact, as mentioned above, the desalination market is growing rapidly and the area that will represent the majority of the market is geographically close to the company's headquarters. Expansion into this market is not only logical due to geographic proximity but also due to the existence of an existing Desalination Project in which Tagua is currently engaged in Morocco. (Sosa, L. 2024, Interview with Luis F. González Sosa) In addition, the market in the Middle East and Afrika region appears as fragmented, hence the concentration is low. This implies a fragmented landscape with numerous players involved and a market that is not stable yet and there are opportunities for new entrants. Moreover, even if the treats should not be underestimated, Tagua find itself in an advantageous position due to the patents it holds on their technology. This allows the selection of different entry modes, it could enter on its own but also opt for licensing to generate revenue without significant investment or joint ventures to share resources and risks.

- **Medium Term (5-10 years)**

*(Author: Jose Prada)*

After a general analysis of the company, we realized that it is important to address the issue of electric cars. Leasing electric vehicles for the company in Tenerife would represent a mobility restructuring model with several benefits in terms of cost reduction, sustainability and efficiency. In economic terms, leasing has advantages such as: not requiring a very high initial investment, thus being able to direct the funds to other strategic sectors of the company, in addition to ensuring cost reduction, given that the fixed monthly payment includes expenses such as maintenance, insurance and associated services, such as tires. This approach allows the company to benefit from tax incentives and state support, which is becoming increasingly implicit in Europe.

From an environmental point of view, replacing diesel vehicles with electric vehicles contributes significantly to the reduction of greenhouse gas emissions, which is directly aligned with the Sustainable Development Goals and the circular economy. In

Tenerife, the geographical conditions allow the use of electric vehicles due to the short distances and the increasing number of fast and super-fast charging stations, optimizing efficiency and operational viability. In addition, leasing allows TAGUA constant access to the most modern technologies, without the challenges associated with asset depreciation, allowing the company's fleet to remain up-to-date and efficient.

By opting for this mobility modality, TAGUA reinforces its position in the market in terms of innovation and sustainability, thus improving its image with customers and suppliers and, very importantly, with the local community. This reinforcement can have a positive impact on attracting new customers and consolidating strategic partnerships. In conclusion, by opting for a sustainable mobility solution, TAGUA directly contributes to reducing decarbonization and developing a more sustainable economy, consolidating its role as a transformative agent in Tenerife.

Therefore, the option of renting electric vehicles as a company strategy is not only related to cost reduction but can also strengthen its position as a reference for innovation and sustainability in the water sector, promoting long-term tangible and intangible benefits.

- **Long Term (10 years and more)**

*(Author: Irene Sabia)*

The results of the above analysis highlight the possibility of turning what is currently a waste product of the process, brine, into a very important resource. The research analyses several applications in which brine can be reused and become a resource: extraction of scarce elements such as lithium, an energy source, irrigation for plants and input for aquaculture. Given the large energy use that the process requires, the possibility of extracting further energy from waste products is promising for the future of the industry. Furthermore, through the use of Pressure Retarded Osmosis, the energy generated would be totally green. The possibility of recovering energy initially from high-pressure brine has already represented a crucial transformation of the industry in the past. Thanks to Energy Recovery Devices (ERDs) and particularly the PX Pressure Exchanger in reverse osmosis plants, it has been possible to recover 99% of the initial energy and thus significantly lower the input required by the system.

For this reason, it is crucial that Tagua, and research in general, does not miss out on further optimization and recovery of resources that could transform the industry and the related clean energy sources to power it. At the same time, combined models such as those designed by Oron and Sánchez take resource utilization to extremes, not stopping at rebalancing inputs and outputs, but adding to the environmental and economic aspects.

In summary, the transformation of brine into a resource is a significant step towards a more sustainable and regenerative industry. This would be done by allowing the reuse of a fundamental and scarce resource, at the end of its life cycle, as an in-out for other applications. Hence decreasing the total use of it globally without the detriment of the economic benefit. In fact, regardless of the sector chosen by the company, the reuse

of brine would lead to an additional stream of revenues from the rare minerals, agriculture and aquaculture. Therefore, the last step of the proposed strategic and investment plan consists in reinvesting the profits obtained from the market expansion and the annual savings of electric machines in partnership with universities and research institutions.

## Discussion and Next Steps

*(Author: Faysal Islam)*

The challenges faced by the desalination industry, particularly those outlined in TAGUA's operations, underscore the urgent need for innovative and sustainable solutions. While efficient, reliance on reverse osmosis technology has led to significant environmental concerns such as brine discharge, greenhouse gas emissions, and marine ecosystem disruption. However, these challenges also present opportunities. The implementation of renewable energy sources, advancements in brine mining, and exploration of emerging technologies like Pressure Retarded Osmosis can pave the way for a more circular and sustainable model. Strategically, TAGUA can address immediate operational inefficiencies through short-term goals like enhanced branding and market penetration, while planning for medium-term investments in energy efficiency and infrastructure upgrades. Long-term strategies must focus on transforming waste into valuable resources and adopting innovative practices to secure environmental and economic benefits. By aligning with global sustainability goals and fostering collaboration with research and industry partners, TAGUA is well-positioned to lead the desalination sector toward a greener future. This approach mitigates environmental impact and unlocks new revenue streams, ensuring resilience and competitiveness in an evolving market.

## 3.3. Loro Parque

### Company Overview

*(Author: Jorge Novais)*

Established in 1972, Loro Parque is a conservation center and zoological park, known well in Puerto de la Cruz of Tenerife in the Canary Islands, Spain. Although a parrot sanctuary when first established, today, in addition to the island's premier tourist product, it has become the leading conservation park for wildlife, with a collection of animal species and a tempting offer for education for visitors. It is privately owned and operated by the Kiessling family.

**History and Foundation**

Founded by Wolfgang Kiessling, a German entrepreneur with a passion for parrots and wildlife conservation, the park began with only 13,000 square meters of area, again primarily devoted to parrots. But soon enough, it expanded due to the rising popularity and the highest quality care for animals and excellent experience for visitors. Today, it covers more than 135,000 square meters (about half the area of a large shopping mall) and attracts millions upon millions of visitors annually.

**Operations and Experiences**

Loro Parque contains more than 4,000 animals of over three hundred and fifty different species, such as parrots, dolphins, orcas, gorillas, penguins, and exotic reptiles. It includes various exhibits, such as the Katandra Treetops aviary, the Planet Penguin habitat, and Orca Ocean. And it is also, as we have experienced, very well known for its shows and experiences that promote awareness of environmental issues. The state-of-the-art techniques in animal welfare and habitat simulation have made its facilities benchmark for similar institutions worldwide.

**Conservation and Education**

Loro Parque is engaged in conservation and education heavily through the foundation, the Loro Parque Fundación. Since its incorporation in 1994, the foundation has invested millions of euros in projects that protect threatened species and their habitats, particularly the endangered parrots. So far, they have managed to save 12 species from extinction, something they are very proud of.

## Current Status of the Company

*(Author: Mahek Suchdev)*

### Loro Parque's Focus on Sustainability

Loro Parque is based in Tenerife, Spain. It was a traditional zoo initially, but its more focus is on sustainability and conservation now. The Foundation is trying its best to follow circular economy principles to reduce its environmental impact, protect biodiversity, and educate the people about sustainable approaches. Its operations emphasize eco-friendly technologies, effectively managing resources, and community engagement to have a balance between entertainment and environmental responsibility.

### Practicing Circular Economy in Daily Operations

- Efficient Waste Management

Loro Parque has been actively participating in reducing waste materials, reusing and recycling. The park has installed very innovative systems that help to separate recyclable materials and organic garbage. Through prominent recycling bins and signs, these systems guarantee low landfill inputs and promote good visitor behavior. The objective is to develop a zero-waste operational model that other facilities can use.

- Systems for Recycling Water

To cut down on freshwater usage, the park has made large investments in water recycling systems. Water used in marine exhibitions is treated by sophisticated filtration systems to ensure safe reuse. Given Tenerife's arid climate and scarce supply of freshwater, this invention is very important.

- Energy Efficiency and Renewable Energy Use

To lessen its reliance on fossil fuels, Loro Parque incorporates renewable energy into its infrastructure. A large portion of the park is powered by solar panels and energy-efficient equipment, which helps the park achieve its goal of reducing its carbon footprint. The park's goal to become carbon neutral in the future is reflected in plans to increase the usage of renewable energy.

- Plastic Reduction Initiatives:

Loro Parque has removed single-use plastics from its activities in an effort to reduce plastic pollution. Reusable materials and biodegradable substitutes are in practice in its restaurants and shops. The park's Commitment to preserve marine ecosystems, which are especially insensitive to plastic trash, is in line with these initiatives.

### Biodiversity Conservation and Research Leadership

- Protection of Endangered Species

Loro Parque's conservation and breeding initiatives, especially for endangered species, have earned it recognition on a global scale. The park now has the greatest

collection of parrot species in the world thanks to its efforts to conserve parrots (Psittacidae). These initiatives concentrate on growing the population while carrying out studies to guarantee their long-term existence.

- Focus on Marine Conservation

Orca, dolphin, and other marine species protection are among the many aspects of marine conservation that Loro Parque is actively involved in. Its aquariums offer a regulated setting for researching animals endangered by habitat loss, overfishing, and climate change. Research collaborations with global marine organizations strengthen the park's position as a marine conservation leader.

- Collaboration with the Loro Parque Foundation

The Loro Parque Foundation, the park's charitable organization, funds more than 200 initiatives across more than 30 Countries. These initiatives tackle urgent worldwide concerns like ocean acidification, deforestation, and the preservation of endangered species. The park's commitment to world biodiversity is demonstrated by the foundation's research and financial contributions.

**Public Education and Engagement**

Loro Parque Foundation’s sustainability objective is public education. Its activities and exhibits aim to educate visitors about environmental challenges while highlighting the part that each person can play in bringing about constructive change.

- Interactive Exhibits

The park illustrates circular economy concepts including energy production and water recycling with interactive displays. All ages may grasp difficult sustainability ideas thanks to these exhibits, which promote a greater awareness of environmental responsibility.

- Events and Campaigns

Loro Parque's conservation message is reinforced by frequent campaigns against wildlife trafficking, plastic pollution, and climate change. In order to engage young minds in sustainability concerns, the park regularly conducts workshops and educational programs for schools.

- Eco-Friendly Experiences for Visitors

Loro Parque makes sure that its activities follow its sustainability laws. For instance, Restaurants provide environmentally friendly food packaging, and guests are urged to consume as few resources as possible while they are there. These steps guarantee that every facet of the tourist experience reflects the park's principles.

Dedication to Innovation

Loro Parque is always looking for new ways to improve its sustainability initiatives. Enhancing operational effectiveness, preserving biodiversity, and tackling global

environmental issues all depend heavily on research and development. The park continues to be a leader in environmental stewardship because it invests heavily in technologies.

As it stands, Loro Parque is a prime example of how a huge organization can incorporate the concepts of the circular economy into its primary objective. The park exemplifies a comprehensive approach to sustainability, from effective resource management to biodiversity conservation. It succeeds by fusing operational effectiveness with a worldwide influence, making sure that it not only lessens its environmental impact but also motivates others to take action. Loro Parque is a shining example of the circular economy, setting the standard for eco-friendly travel.

## Research Focus

*(Author: Theogene Maniraguha)*

### Renewable Energy Transition and Carbon Footprint Challenges

Loro Parque has made significant strides in renewable energy adoption, positioning itself as a leader in sustainability efforts on Tenerife. Its photovoltaic park generates 2.75 MW of power, and a forthcoming wind turbine is projected to produce 12.5 MW, collectively preventing over 2,000 tons of CO2 emissions annually. These efforts highlight Loro Parque's commitment to reducing reliance on fossil fuels and aligning with global climate goals (Parque, 2023).

However, recent regulatory updates challenge the recognition of such initiatives. Under new carbon footprint methodologies, renewable energy contributions from solar and wind are excluded from emissions calculations, fundamentally altering how carbon neutrality is defined. This shift undermines Loro Parque's investments in clean energy and their ability to claim a negative carbon footprint, despite tangible benefits to the environment (Parque, 2023).

The exclusion of renewable contributions creates a paradox for entities like Loro Parque that heavily invest in sustainability. While these projects demonstrably reduce CO2 emissions and lessen reliance on imported diesel, their impacts are no longer fully recognized in official metrics. This not only diminishes public recognition of these efforts but also complicates the park's ability to secure certifications and maintain its leadership position in sustainable tourism.

Moreover, this regulatory shift highlights broader challenges in integrating renewable energy into regional energy systems. The Canary Islands, heavily reliant on imported fossil fuels, aim to decarbonize by 2040. However, the lack of a consistent framework acknowledging renewable energy's contributions risks discouraging private-sector initiatives that are essential for achieving these goals. Loro Parque, as a major stakeholder, could advocate for updated regulations that align carbon accounting practices with the realities of renewable energy's benefits,

In response to these challenges, Loro Parque could enhance its efforts by diversifying renewable projects to include technologies like geothermal energy or small-scale tidal systems, which align with regional priorities. Additionally, engaging in policy dialogues to push for internationally standardized carbon accounting systems could ensure fair recognition of renewable contributions. Through these measures, Loro Parque can maintain its role as a sustainability leader while supporting Tenerife's broader decarbonization efforts.

### Waste Management and Circular Economy Integration

Loro Parque has implemented extensive measures to address waste management challenges, prioritizing composting organic waste and recycling materials generated by the high number of visitors. Despite these efforts, the sheer volume of waste

produced daily presents ongoing challenges, requiring constant refinement of processes and visitor education programs to ensure effective waste disposal.

The high volume of visitors—often exceeding millions annually—generates a significant amount of mixed waste, which complicates sorting and recycling processes. For instance, improperly sorted waste in recycling bins can contaminate materials, rendering them unsuitable for recycling and increasing disposal costs. Moreover, a lack of awareness among visitors regarding proper waste separation often leads to inefficiencies in the park's waste management systems (Small-scale Waste-to-Energy projects in the Canary Islands, 2023).

**Water Management and Resource Conservation**

Water management and resource conservation present critical challenges for Loro Parque, particularly due to its operational demands and the unique environmental conditions of Tenerife. These challenges are not only immediate but also foreseeably significant as environmental pressures and resource constraints increase.

- Dependence on Desalination and Energy Demand

Loro Parque relies on a desalination plant that produces 600,000 liters (about 158503.2 gal) of fresh water daily to meet its operational needs. While this ensures independence from Tenerife's limited natural water supplies, desalination is an energy-intensive process. Conventional desalination often depends on fossil fuels, which not only increases operational costs but also conflicts with Loro Parque's sustainability goals. As Tenerife pushes for decarbonization by 2040, aligning desalination with renewable energy becomes imperative but requires significant investments.

- Rising Water Demands from Tourism and Operations

The high number of visitors annually adds to Loro Parque's water usage. The park must maintain aquatic exhibits, provide animal welfare, and manage extensive landscaping, all of which require substantial water resources. As tourism in Tenerife continues to grow, the competition for water between residents, tourists, and businesses like Loro Parque is likely to intensify. Meeting these demands without compromising environmental and community water needs is a pressing concern.

- Regulatory and Environmental Pressures

Regulatory changes in the Canary Islands are likely to increase expectations for sustainable water management. As Tenerife intensifies its focus on renewable-powered solutions and regional water-sharing initiatives, Loro Parque might face pressures to expand its desalination capacity to benefit the surrounding communities. While this presents an opportunity for social impact, it also adds operational complexity and financial strain, particularly if the park must upgrade its infrastructure to integrate renewable energy sources.

- Climate Change and Water Scarcity

Tenerife is vulnerable to the impacts of climate change, including prolonged droughts and increased water scarcity. These factors could exacerbate the strain on the island's water resources and amplify the challenges faced by Loro Parque in ensuring a consistent water supply. Climate variability may also affect the park's operational costs and its ability to maintain the quality and quantity of water required for its exhibits and facilities.

By addressing these foreseeable challenges through innovative technologies, partnerships, and community-focused solutions, Loro Parque could further its leadership in sustainability while adapting to evolving environmental and regulatory demands. However, these challenges highlight the need for strategic planning and investments to align the park's water management practices with long-term sustainability goals.

**Conservation and Biodiversity Protection**

The Loro Parque Fundación is a cornerstone of Loro Parque's commitment to conservation, supporting over 200 projects globally. These initiatives focus on safeguarding endangered species, including green sea turtles (Chelonia mydas) and hammerhead sharks (Sphyrna spp.), which face significant threats from habitat loss, overfishing, and climate change. While these efforts have led to measurable conservation successes, sustaining them presents challenges due to their cost and reliance on fluctuating tourism revenues.

- Global Conservation Impact

Loro Parque Fundación's projects span diverse ecosystems, addressing critical threats to biodiversity. For instance, the foundation has successfully reintroduced the Lear's macaw (Anodorhynchus leari) into its natural habitat in Brazil, bringing this species back from the brink of extinction. Similarly, marine conservation programs, such as those targeting hammerhead sharks, focus on reducing illegal fishing and protecting critical habitats.

In Tenerife, the Fundación collaborates with local initiatives to protect vulnerable marine species, including green sea turtles, which are at risk due to pollution and habitat degradation. These projects not only aim to conserve species but also raise awareness about the interconnectedness of marine ecosystems and human activity.

- Challenges of Sustaining Conservation Efforts

Despite these achievements, maintaining biodiversity protection programs is resource intensive. Fluctuations in tourism revenue, particularly during global disruptions like the COVID-19 pandemic, directly affect funding availability. Conservation projects often rely on tourism income to support research, staff salaries, and community outreach. When revenues decline, programs risk scaling back or halting altogether.

Additionally, addressing biodiversity loss in a changing climate requires innovative approaches and substantial investment. For example, rising ocean temperatures and acidification threaten coral reefs, essential habitats for many marine species, including those targeted by the Fundación's conservation programs. Adapting to these challenges involves advanced research, such as developing heat-resistant coral strains or implementing habitat restoration techniques.

- Expanding Resource Allocation

To ensure the continuity of its programs, Loro Parque Fundación could diversify its funding sources. Partnering with international conservation organizations, securing grants, and engaging corporate sponsors could provide more stable financial backing. For instance, collaborations with entities like the International Union for Conservation of Nature (IUCN) or the Global Environment Facility (GEF) could amplify the foundation's reach and resource base.

Moreover, Loro Parque could leverage its global reputation to promote citizen science initiatives, enabling visitors and online supporters to contribute directly to conservation efforts. Examples include sponsoring tagged marine species for monitoring or participating in local habitat clean-up campaigns. These initiatives not only raise funds but also deepen public engagement with conservation goals.

- Future Directions in Biodiversity Protection

Expanding the Fundación's focus to address climate resilience is a crucial next step. This could include fostering mangrove reforestation to protect coastlines and enhance carbon sequestration or working with research institutions to monitor the genetic diversity of endangered species to increase their adaptability to environmental changes. By aligning these projects with global conservation priorities, Loro Parque Fundación can continue to set benchmarks in biodiversity protection while addressing emerging ecological challenges.

By sustaining and evolving its conservation strategies, Loro Parque Fundación not only safeguards biodiversity but also reinforces its role as a global leader in environmental stewardship. These efforts demonstrate the profound impact of focused conservation initiatives and their essential role in addressing the global biodiversity crisis.

**Addressing Public Perception and Ethical Concerns**

The role of orcas at Loro Parque has been a subject of growing criticism, particularly concerning their portrayal and treatment in captivity. Critics argue that Loro Parque's depiction of orcas as performers rather than apex predators undermines their ecological significance and natural behaviors. This narrative not only distorts public understanding but also raises ethical concerns about the treatment of highly intelligent marine mammals in captivity.

One key issue highlighted by animal welfare organizations, such as the Dolphin Project, is the "downgrading" of orcas' roles as apex predators. Orcas, known for their complex social structures and cooperative hunting strategies in the wild, are presented

in performances focused on entertaining audiences rather than educating them about their ecological roles. Such portrayals can mislead the public about the challenges orcas face in the wild, such as climate change, overfishing, and pollution, further alienating them from their natural context.

Additionally, incidents involving aggression and frustration among captive orcas, like Keto's case, point to the psychological toll captivity takes on these animals. Reports from the Whale Sanctuary Project describe how restrictive environments can lead to stress and dangerous behaviors, emphasizing the unsuitability of confining such large, socially intricate animals. These challenges underscore a need for more ethical approaches, such as the development of sanctuaries that allow for more naturalistic living conditions while still enabling educational outreach and conservation efforts.

Together, these points highlight the disconnect between Loro Parque's practices and the growing global call for ethical, conservation-focused animal care. Addressing these issues could involve a shift toward sanctuary-based models and more accurate educational programming to align public engagement with the ecological realities of orcas.

## Results and Recommendations

*(Author: Parth Rajendra, Harsh Lokhande)*

Loro Parque's commitment to sustainability is underpinned by a comprehensive strategy that emphasizes the adoption of innovative practices, active stakeholder collaboration, and alignment with international environmental frameworks (Loro Parque Foundation, n.d.). By leveraging its position as a leader in conservation and sustainability, the organization seeks to address contemporary environmental challenges through scalable and impactful initiatives. This chapter focuses on three proposed projects—banana leaf wrappers, a gamification-based visitor engagement system, and a clothing recycling program. These initiatives are assessed in terms of their potential environmental and economic benefits, feasibility, and alignment with circular economy principles. Together, they exemplify Loro Parque's ambition to transition from traditional sustainability practices toward a regenerative and restorative model.

## Results and Impact Assessment

### *Banana Leaf Wrappers Initiative*

- **Key Insights**

The agricultural sector in Tenerife generates an estimated 220,000 tons of banana-related waste annually, much of which remains underutilized or discarded. Repurposing banana leaves as biodegradable packaging offers an innovative solution to two pressing environmental challenges: the reduction of plastic waste and the mitigation of agricultural byproduct disposal. Estimates suggest that replacing plastic packaging with banana leaf wrappers could eliminate up to 150 tons of plastic waste annually while reducing greenhouse gas emissions by approximately 20 tons of $CO_2$-equivalent each year. These figures highlight the dual environmental benefits of this initiative—minimizing plastic pollution and promoting carbon savings through waste valorization (Loro Parque Foundation, n.d.; Tenerife South Guide, n.d.).

- **Economic Potential**

The project offers a compelling economic incentive for local farmers. Currently, banana leaves are considered agricultural waste, with little to no market value. Under this initiative, farmers could earn between €50 and €100 per ton of banana leaves, effectively turning an underutilized byproduct into a source of additional income. This not only fosters economic resilience within the agricultural community but also incentivizes sustainable farming practices, aligning with the principles of the circular economy (Papyrus Australia, n.d.).

- **Challenges and Proposed Solutions**

    - Durability and Functionality

Banana leaves, while biodegradable and readily available, are prone to tearing, decomposition, and moisture absorption, which limits their usability as a packaging material.

**(a) Proposed Solution**: Enhance the structural integrity of banana leaves through treatments such as bio-coating with biodegradable resins or lamination using natural waxes. These methods can improve moisture resistance, extend shelf life, and ensure the wrappers perform reliably in diverse environmental conditions.

- **Energy-Intensive Processing**

The processes required to prepare banana leaves for use, including blanching, drying, and pressing, are energy-intensive. Without intervention, these processes could undermine the sustainability goals of the project.

**(a) Proposed Solution**: Transition to renewable energy sources, such as solar or wind power, for processing. Additionally, explore energy-efficient technologies, like solar drying systems or low-energy blanching equipment, to minimize

operational energy demands and carbon emissions (Ellen MacArthur Foundation).

- **Supply Chain Reliability**

Banana production is subject to seasonal fluctuations, and over-reliance on a single material could disrupt the supply chain.

**(a) Proposed Solution**: Establish material diversification strategies by exploring other agricultural byproducts, such as sugarcane bagasse, corn husks, or palm leaves. By incorporating multiple materials, the initiative can ensure year-round supply and reduce dependency on a single resource

- **Recommendations**

1. **Pilot Program Implementation**
   Initiate a pilot program in collaboration with local farmer cooperatives and packaging manufacturers. The program should focus on testing the scalability and functionality of banana leaf wrappers across different applications, such as food packaging or product wrappings. Metrics such as production efficiency, market demand, and user satisfaction should be tracked to assess the program's feasibility.

2. **Market Integration and Branding**
   Launch targeted marketing campaigns to position banana leaf wrappers as a premium, eco-friendly alternative to plastic packaging. This could include partnerships with local businesses, such as restaurants, hotels, and souvenir shops, to introduce the wrappers in real-world scenarios. Highlighting the unique "Tenerife-grown" aspect of the packaging could further enhance its appeal, particularly for sustainability-conscious tourists.

3. **Research and Development on Material Alternatives**
   Invest in research to identify complementary plant-based materials that could be used alongside banana leaves. Materials such as sugarcane bagasse or palm fibers, which share similar properties, could be processed using existing equipment and provide a consistent supply chain even during seasonal shortages.

4. **Stakeholder Engagement and Policy Advocacy**
   Collaborate with local government agencies and environmental organizations to align this initiative with Tenerife's broader sustainability goals. Advocacy efforts could include lobbying for policy incentives, such as subsidies or tax breaks, for businesses adopting biodegradable packaging solutions.

*Gamification Ecosystem*

- **Key Insights**

Gamification has the potential to engage Loro Parque's over 1 million annual visitors in meaningful ways, encouraging sustainable behaviors and aligning individual actions with the park's overarching sustainability objectives. By using interactive challenges, rewards, and educational experiences, gamification can transform routine visitor activities into impactful environmental contributions (IAAPA, n.d.; UNEP, 2020).

- **Sustainability Impact**

This initiative could deliver tangible environmental benefits. For example:

(a) Reverting an estimated **500 kg of plastic waste annually** through incentivized recycling efforts.

(b) Supporting biodiversity conservation by funding the planting of **10,000 trees annually**, which contributes to carbon sequestration and habitat restoration (N-Gage, n.d.; Loro Parque Foundation, n.d.).

- **Economic Potential**

Eco-rewards, such as discounts on merchandise or priority access to attractions, could drive additional revenue through increased ticket sales and enhanced customer loyalty. By integrating these rewards into the park's sustainability programs, the gamification initiative could open new revenue streams while reinforcing Loro Parque's brand as a leader in eco-tourism (IAAPA, n.d.).

- **Challenges and Proposed Solutions**

    - Development Costs

The initial development of gamification platforms is projected to cost between **€50,000 and €75,000**, a significant investment for the park.

(a) **Proposed Solution**: Prioritize funding through sponsorships, grants, or partnerships with technology providers. Demonstrating measurable returns on investment, such as increased merchandise sales or greater engagement in conservation activities, can justify the upfront costs.

    - Energy Consumption

Operating gamification platforms, including apps and interactive kiosks, requires electricity, potentially increasing the park's carbon footprint.

(a) **Proposed Solution**: Power digital platforms using renewable energy sources. This ensures alignment with Loro Parque's environmental goals and reinforces its commitment to carbon-neutral operations (UNEP, 2020).

- **Recommendations**

1. **Integrated Rewards System**
   Incorporate gamification rewards into existing sustainability initiatives. For example:

   (a) Visitors earn eco-points for using banana leaf packaging or recycling clothing at the park.

   (b) Points can be redeemed for eco-friendly souvenirs, discounts, or exclusive experiences, creating a circular incentive loop that aligns individual actions with sustainability objectives.

2. **Direct Support for Conservation Programs**
   Leverage eco-points to fund tangible conservation efforts, such as tree-planting campaigns or marine biodiversity projects. This allows visitors to see the direct environmental impact of their participation, fostering deeper engagement and long-term loyalty.

3. **Scalability Across Activities**
   Expand gamification into a broader ecosystem that interconnects various sustainability initiatives. For instance, eco-points could track contributions across multiple touchpoints, including reducing waste, purchasing eco-friendly products, or participating in educational activities.

4. **Strategic Partnerships**
   Collaborate with local tech developers and global organizations specializing in gamification platforms to minimize costs and optimize user experience. Partnerships with environmental NGOs could also enhance the credibility and reach of conservation-linked rewards.

### *Clothing Recycling Bins*

- **Key Insights**

Tenerife's limited infrastructure for textile recycling presents a significant opportunity for Loro Parque to establish a program that addresses both environmental and economic challenges. By implementing clothing recycling bins throughout the park, the initiative could divert an estimated **10 tons of textile waste annually** from landfills. This reduction in waste directly mitigates methane emissions, a potent greenhouse gas released during textile decomposition, thereby contributing to the park's sustainability objectives (Ellen MacArthur Foundation, n.d.; Loro Parque Foundation, n.d.).

- **Economic Potential**

Recycling textiles into upcycled merchandise, such as eco-branded tote bags and apparel, offers a lucrative revenue stream. The program could generate approximately **€20,000 annually**, bolstered by partnerships with NGOs to lower operational costs.

These products not only create an additional source of income but also reinforce Loro Parque's brand identity as a leader in sustainable tourism (N-Gage, n.d.).

- **Challenges and Proposed Solutions**

    - Operational Energy Consumption

Textile sorting and recycling require machinery that can increase energy use, potentially offsetting some of the sustainability gains.

(a) **Proposed Solution**: Transition to machinery powered by renewable energy sources, such as solar or wind, to reduce the carbon footprint of operations.

**Logistics and Quality Control**
Ensuring high-quality standards for upcycled merchandise is critical for customer satisfaction and brand reputation. This requires efficient sorting, cleaning, and production processes.

(a) **Proposed Solution**: Optimize logistics by adopting scalable practices, such as automated sorting systems and establishing partnerships with local suppliers experienced in textile recycling.

- **Recommendations**

1. **Competitor Analysis and Market Positioning**
   Conduct a thorough competitor analysis to identify market gaps and position Loro Parque as a pioneer in sustainable textile recycling. Highlight the uniqueness of eco-branded products, particularly those linked to the park's conservation efforts, to differentiate them from existing offerings.
2. **Strategic NGO Collaboration**
   Partner with NGOs experienced in textile recycling to streamline operations and reduce startup costs. Collaborations could include shared facilities, joint marketing campaigns, and technical expertise to ensure efficient implementation.
3. **Visitor Engagement and Awareness Campaigns**
   Educate visitors about the environmental impact of textile waste and the benefits of recycling through interactive exhibits and social media campaigns. Incentivize participation by offering discounts or eco-points redeemable within the park for every clothing donation.
4. **Upcycled Product Diversification**
   Expand the product range to include customizable items, such as branded apparel or souvenir quilts, to cater to diverse visitor preferences. Promoting limited-edition collections tied to specific conservation campaigns could also enhance demand and create exclusivity.

**Feasibility and Circular Economy Contributions**

*Banana Leaf Wrappers Initiative*

**Objective**: To repurpose banana leaves as biodegradable and sustainable alternatives to single-use plastics.

**Technical Feasibility**:

(a) **Current Availability**: Tenerife's extensive banana cultivation produces significant agricultural waste, including banana leaves, which are traditionally discarded. These leaves exhibit flexibility, waterproof qualities, and biodegradability, making them viable substitutes for plastic packaging (Global Scientific Journal).

(b) **Processing Requirements**: Minimal processing, such as cleaning, drying, and shaping, is required. Existing packaging technologies can be modified to accommodate this material.

(c) **Challenges**: Further research is necessary to enhance the durability of banana leaf packaging, particularly to address moisture retention and resilience under diverse conditions.

**Economic Feasibility**:

(a) **Costs**: Low raw material costs since banana leaves are currently treated as agricultural waste. Initial investments in processing equipment are moderate and scalable.

(b) **Revenue Potential**: Banana leaf packaging can be priced competitively with compostable plastics while adding branding value (e.g., "Eco-wrapped in Tenerife").

(c) **Farmer Benefits**: Farmers could earn an additional revenue stream, estimated at €50–€100 per ton of banana leaves, incentivizing sustainable agricultural practices.

**Social Feasibility**:

(a) **Community Impact**: Increases farmer income and supports sustainable agriculture, fostering local community resilience.

(b) **Stakeholder Support**: Likely to attract support from local agricultural cooperatives and environmental advocacy groups.

**Environmental Feasibility**:

(a) **Waste Reduction**: Redirects agricultural waste from landfills, reducing methane emissions and contributing to a circular waste cycle.

(b) **Composability**: Fully biodegradable and integrates seamlessly into a closed-loop system.

**Overall Feasibility**:
High, contingent upon pilot testing to validate the material's durability and scalability.

### *Gamification Ecosystem*

**Objective**: To encourage eco-friendly behaviors through a gamified system that combines digital engagement with tangible incentives.

**Technical Feasibility**:

(a) **Current Technology**: Platforms for app development and QR code integration are readily available and can be adapted for recycling and eco-point systems.

(b) **Challenges**: Development costs and ensuring user adoption will require strong marketing and ongoing technical support.

**Economic Feasibility**:

(a) **Costs**: Initial development costs are estimated between €50,000–€75,000, with additional maintenance costs based on user base size.

(b) **Revenue Potential**: Increased visitor spending is anticipated through redeemable eco-incentives, such as discounts on merchandise and eco-branded products.

(c) **ROI**: Enhanced engagement could boost ticket sales and eco-product purchases, offsetting initial costs over time.

**Social Feasibility**:

(a) **Community Engagement**: Encourages active participation in sustainability efforts, particularly appealing to younger, tech-savvy audiences.

(b) **Education**: Provides an engaging platform to educate visitors about the principles of the circular economy.

**Environmental Feasibility**:

(a) **Waste Reduction**: Could divert an estimated 500 kg of plastic waste annually by incentivizing recycling efforts.

(b) **Behavioral Impact**: Promotes sustainable habits such as using public transport, reducing single-use plastics, and engaging with conservation initiatives.

**Overall Feasibility**:
Moderate, as the success of the initiative hinges on effective user engagement, robust marketing, and a clear ROI analysis.

### *Clothing Recycling Bins*

**Objective**: To establish clothing recycling bins throughout the park, enabling textile recycling and upcycling into new products.

**Technical Feasibility**:

- **Infrastructure**: Requires strategic bin placement within the park and partnerships for collection and sorting processes.
- **Challenges**: Ensuring proper maintenance and preventing contamination of collected textiles will require consistent oversight.

**Economic Feasibility**:

- **Costs**: Initial costs include €300–€500 per bin, alongside operational expenses for logistics and sorting.
- **Revenue Potential**: Upcycled textiles can be repurposed into eco-branded merchandise, such as bags or apparel, or sold to recycling companies.
- **Market Potential**: Limited textile recycling options in Tenerife present a unique opportunity, positioning this initiative as a distinctive offering in the local market.

**Social Feasibility**:

- **Community Impact**: Involves local NGOs and communities in the recycling process, fostering inclusivity and promoting environmental awareness.
- **Stakeholder Support**: Likely to gain traction among eco-conscious visitors, local residents, and sustainability groups.

**Environmental Feasibility**:

- **Waste Diversion**: Could prevent an estimated 10 tons of textiles from entering landfills annually, significantly reducing methane emissions.
- **Circularity**: Supports the reuse of materials, promoting a zero-waste culture and reducing environmental impact.

**Overall Feasibility**:
High, as the initiative involves minimal technical barriers and aligns strongly with social and environmental goals.

### *Contributions to the Circular Economy*

Each of the proposed initiatives contributes significantly to the principles of a circular economy:

1. **Banana Leaf Wrappers**:
    a. **Reduce**: Minimizes reliance on single-use plastics, reducing overall plastic waste.
    b. **Reuse**: Offers biodegradable alternatives that integrate seamlessly into natural composting cycles.
    c. **Restore**: Diverts agricultural waste from landfills, reducing methane emissions and enhancing soil health through composting.

2. **Gamification Ecosystem**:
    a. **Reduce**: Encourages behaviors that reduce waste and single-use plastics.
    b. **Reuse**: Rewards eco-friendly actions, fostering a culture of material reuse.
    c. **Restore**: Channels engagement into conservation initiatives, such as tree planting, contributing to habitat restoration and carbon sequestration.

3. **Clothing Recycling Bins**:
    a. **Reduce**: Diverts textiles from landfills, decreasing methane emissions and waste buildup.
    b. **Reuse**: Promotes upcycling into eco-friendly merchandise, extending the lifecycle of materials.
    c. **Restore**: Creates a model for material regeneration, advancing zero-waste goals.

*Table 1: Summary of the sustainability analysis*

| Initiative | Technical Feasibility | Economic Feasibility | Social Feasibility | Environmental Feasibility | Key Impacts | Circular Economy Contribution |
|---|---|---|---|---|---|---|
| **Banana Leaf Wrappers** | High | High | High | High | ~150 tons of plastic diverted | Repurposes agricultural waste |
| **Gamification Ecosystem** | Moderate | Moderate | High | High | ~10,000 trees planted; ~500 kg waste | Promotes behavioral change |
| **Clothing Recycling Bins** | High | Moderate | High | High | ~10 tons of textiles diverted | Extends product life; reduces waste |

### *Short-Term Actions (1–3 Years)*

**Leveraging Synergies for Greater Impact**

1. **Gamification Rewards**: Integrate eco-rewards into existing programs to encourage visitor participation in using banana leaf wrappers and recycling bins, thereby enhancing engagement and behavioral impact (IAAPA, n.d.; Ellen MacArthur Foundation, n.d.).

**Pilot Program Implementation**

(a) **Banana Leaf Wrappers**: Conduct pilot trials with local cooperatives to assess scalability, durability, and visitor reception. Measure outcomes like waste reduction and cost-effectiveness (Loro Parque Foundation, n.d.).

(b) **Gamification**: Test a gamification app to track visitor participation, incentivize actions like recycling, and measure engagement metrics such as user activity and eco-point redemption rates.

(c) **Clothing Recycling Bins**: Roll out a limited number of recycling bins across the park to evaluate logistics, operational feasibility, and visitor usage patterns.

**Marketing and Stakeholder Engagement**

(a) **Storytelling Campaigns**: Develop narratives linking initiatives to global biodiversity conservation and community economic upliftment, targeting eco-conscious visitors (Ellen MacArthur Foundation, n.d.; N-Gage, n.d.).

(b) **Visitor Education**: Highlight the benefits of sustainable practices through interactive displays, workshops, and tours, making sustainability part of the visitor experience.

**Water Management and Resource Conservation**

(a) **Community Partnerships**: Collaborate with local governments to extend desalination plant benefits to surrounding communities, addressing regional water scarcity.

(b) **Innovation Grants**: Apply for European Union sustainability funding to support technology upgrades in desalination and water recycling.

**Conservation and Biodiversity Protection**

(a) **Donation Packages**: Introduce conservation-focused visitor packages with optional donation opportunities.

(b) **Crowdfunding**: Launch online campaigns to fund specific biodiversity projects, such as marine habitat restoration or species conservation.

**Renewable Energy Transition**

(a) **Public Reporting**: Enhance the transparency of annual sustainability reports, detailing renewable energy contributions, regulatory challenges, and mitigation efforts.

(b) **Stakeholder Advocacy**: Engage stakeholders with clear communication about the impact of regulatory changes on renewable energy recognition.

*Long-Term Actions (5–10+ Years)*

**Broader Context and Strategic Partnerships**

(a) **Global Advocacy**: Partner with international conservation organizations and forums to align Loro Parque's initiatives with global sustainability goals (Environmental Protection Agency, n.d.; Ellen MacArthur Foundation, n.d.).

**(b) Policy Engagement**: Advocate for policies supporting renewable energy recognition in carbon footprint accounting at international forums.

**Renewable Energy Transition**

(a) **Carbon Offset Programs**: Expand investments in innovative carbon offset projects, such as reforestation, habitat restoration, and marine-based carbon capture technologies.

(b) **Energy Expansion**: Explore and integrate additional renewable energy sources like geothermal or tidal systems to further reduce reliance on fossil fuels.

**Water Management and Resource Conservation**

(a) **Technological Innovation**: Invest in advanced desalination systems powered by renewable energy to address growing water demands while reducing the carbon footprint.

**(b) Regional Impact**: Scale up water-sharing initiatives to provide clean water access to underserved areas in Tenerife, reinforcing Loro Parque's role as a community sustainability leader

**Conservation and Biodiversity Protection**

(a) **Collaborative Research**: Establish partnerships with international conservation bodies to co-develop solutions for climate resilience, such as heat-resistant corals or mangrove restoration.

(b) **Education Expansion**: Broaden species conservation education programs to include school outreach and virtual learning platforms, fostering global awareness of biodiversity challenges.

**Economic Recovery and Sustainability Balance**

(a) **Eco-Tourism Campaigns**: Position Loro Parque as a global leader in sustainable tourism through targeted marketing campaigns.

(b) **Revenue Diversification**: Develop new revenue streams, such as virtual tours, sustainability workshops, and online eco-merchandise, to reduce dependency on visitor ticket sales.

(c) **Travel Alliances**: Partner with travel agencies to create bundled eco-tourism packages, promoting Loro Parque as a must-visit sustainable destination.

## Discussion and Next Steps

*(Author: Jorge Novais)*

Our trip to Tenerife, as well as Loro Parque, was an eye-opening experience of how conservancy and environmental welfare is practiced. With five students in the group, we went on to complete this task focused on the nexus between tourism, preservation and sustainability, ending up with more than just information, but with a changed perception as well.

Loro Parque demonstrates in practice how companies do not have to be financially unviable in order to be environmentally sound and in a way that does not compromise animal welfare. Witnessing its cutting-edge approaches and being taught about its practices showed us what it means to be a viable and restorative business through real examples. Through a wide array of displays and new programs, we also witnessed how these kinds of establishments can serve a dual purpose of educating and motivating the audience to become environmental stewards.

One of the most memorable parts of Loro Parque was the meeting with Patricio, Commercial Manager of Loro Parque. His remarks provided a thorough overview of the issues related to and capable of resolving. He informed us of the innovative directions of development pursued by Loro Parque, which has all the chances of being at the forefront of modern eco-tourism.

On a personal level, our outlook changed because of the experience. Other than the knowledge gained in class, we understood the need to practice what is preached on sustainable ways of living. Witnessing how Loro Parque cares for the environment, we would like to incorporate practices that lead to sustainable life in the future whether it be in the form of reducing wastage, conserving energy usage, or simply advocating for protection of natural resources.

We look back on this experience and cannot help but notice that the work that we have done was also of an academic nature but has had a much larger impact. They have enabled us to gain consciousness of the place of sustainability in business and everyday activities. In the present context, it would be useful to apply the lessons learnt to instigate both organization and self-change to ensure a time comes when businesses like Loro Parque and individuals like us are able to work together towards a better world.

This project has not only enhanced our understanding but has seen us become better citizens keen to promote and engage in sustainability measures.

## 3.4. WOOPTIX

### Company Overview

*(Author: Elene Tsotadze)*

Wooptix is an innovative technology company revolutionizing imaging solutions with its cutting-edge Wavefront Phase Imaging (WFPI) technology. Initially designed for astronomical applications, the technology has evolved to address challenges in semiconductor manufacturing, optical metrology, medical imaging, and light field applications. The company aims to optimize processes, reduce costs, and enhance quality control across multiple domains.

Wooptix was established as a result of the research conducted by the current CEO, José Manuel Ramos who focused his Astrophysics PhD, on Adaptive Optics at the University of La Laguna. Specifically, on how the changes in the refractive index caused by atmospheric turbulence can blur an image (Wooptix, n.d.).

The company was established in 2016. As Wooptix originated in Tenerife, the company has its main headquarters in the Canary Islands, where the labs, tech team and R&D are located.

The Canary Islands offer Wooptix a key location-factor regarding highly trained talent because of two great Astrophysics Observatories residing on the islands: One at the Teide Mountain (Tenerife) and one in El Roque (La Palma). The close contact with the IAC (Canarian Astrophysics Institute) enhances opportunities to share valuable knowledge (Wooptix, n.d.). Additional Wooptix offices are located in Madrid and San Francisco. As of 2024, the company has more than 40 employees. (Pitchbook, n.d.). Most of the employees are students or graduates of the University of La Laguna.

Over the years, Wooptix has secured substantial financial backing from a diverse range of investors. Notable investors include Intel Capital, the venture arm of Intel Corporation; Bullnet Capital, a Spanish venture capital firm that focuses on high-tech startups; and the European Innovation Council (EIC) Fund, an EU initiative designed to support high-impact innovations (EU-Startups, 2023). According to the company's CEO, Wooptix also has a significant private investor based in Madrid who brings not only financial resources but also their own vision about the company's future production strategy.

In 2023 the company has been recognized by the EIC Accelerator Program through a €2.5 million grant in addition to the equity investment. The grant and investment support Wooptix's product introduction and future technological innovation including the manufacture, delivery, and installation of three semiconductor metrology tools in Japan, the USA, and the Netherlands (EU-Startups, 2023).

## Core Technologies and Products

Wooptix's innovative product portfolio is centered around cutting-edge imaging and metrology solutions that leverage its proprietary Wavefront Phase Imaging (WFPI) technology. These products are designed to meet the high precision demands of industries such as semiconductor manufacturing, optical metrology, and biomedical research.

### A New Wavefront Sensor

At the forefront of Wooptix's technology is its revolutionary wavefront sensor. This device provides unprecedented accuracy in wavefront phase measurement, making it an invaluable tool for laser measurement, material inspection, optical metrology, and quantitative phase imaging. The sensor offers high spatial resolution and real-time processing capabilities, enabling precise and continuous wavefront analysis.

The SEBI RT1000 introduces exceptionally high wavefront phase spatial sampling, real-time processing (30 FPS), and absolute Wavefront Accuracy for the most challenging measurement tasks. Wooptix SEBI RT1000 is a small-size implementation of the WFPI technology, and Its standout features include (Wooptix, n.d.):

- High Spatial Sampling: Offers a resolution of 1,000 x 1,000 pixels for intricate wavefront analysis.
- Real-Time Processing: Operates at 30 frames per second, enabling live imaging and continuous monitoring.
- Absolute Accuracy: Delivers wavefront measurements with an impressive λ/30 RMS accuracy.

### Phemet – Semiconductor Manufacturing

Wooptix has developed a system called Phemet, that uses WFPI, a proprietary wavefront sensing technique.

Phemet introduces a new semiconductor wafer geometry technique that measures: shape uniformity, nanotopography, and roughness of the entire silicon wafer in a single image. By collecting more than 10 million data points with subnanometer height resolution, Phemet is the industry leader in speed and resolution (Wooptix, n.d.).

- Nanotopography Measurement: Captures surface variations with sub-nanometer resolution.
- Real-Time Imaging: Provides rapid and automated analysis with over 10 million data points per image.

Phemet enhances manufacturing efficiency by detecting and addressing defects early in the production process. Additionally, the product is evolving, with a fully automated fabrication tool scheduled for release in the near future, promising even greater efficiency for semiconductor manufacturers.

## Current Status of the Company

*(Author: Elene Tsotadze)*

Wooptix is at an evolving stage in integrating circular economy principles and sustainability into its operations. While the company is navigating significant challenges related to finances, production scalability, and client acquisition, it remains committed to fostering a sustainable future. Based in Tenerife, Wooptix envisions leveraging the island's natural resources by adopting solar and wind panel systems to power its operations, reducing carbon emissions, and aligning with global sustainability goals.

The company has a dedicated part on its webpage on sustainability. Additionally, Wooptix actively promotes sustainability through informative articles and papers available on its website. These publications highlight the company's commitment to environmentally responsible practices and its innovative approaches to reducing ecological impact.

Publications:

1. "RT 1000 Helps the Planet": This article discusses the significant environmental footprint of laboratories, emphasizing the high energy consumption of ultra-low temperature freezers and the substantial plastic waste generated annually. Wooptix introduces the SEBI RT1000 phase camera as a solution, enabling real-time microscopic observations without the need for chemical dyes. This innovation reduces material consumption and simplifies waste disposal, contributing to more sustainable laboratory practices (Wooptix, n.d.).
2. "Enhancing the Quality Control of Solar Panels with a Phase Camera": Wooptix's advanced camera technology ensures that both manufacturers and consumers benefit from peak performance in solar panels. By providing precise quality control, the company supports the production of efficient renewable energy solutions, aligning with global sustainability goals (Wooptix, n.d.).

## Research Focus

*(Author: Helge Gevekoth)*

In the first meeting with José Manuel Ramos, the team discovered the broad variety of Wooptix's products. As the company currently is still in the development stage in all their products, a market introduction is the next step the company wants to accomplish. The insights from José Manuel Ramos revealed that the company plans to launch the first 100 pieces of their SEBI product in 2025. Product demand is projected to increase in the following years, requiring an increase in production levels. In the long term, Wooptix aims for local manufacturing, meaning to produce near to the point of use where the demand exists. To meet the initial demand, Wooptix is currently planning their first centralized production facility and the optimal location.

As mentioned in the company overview Wooptix has a number of investors. According to José Manuel one investor from mainland Spain has a strong opinion on the topic of

the production location. The investor argues that the most logical choice for production location is Madrid, Wooptix's secondary hub. In his opinion, the choice of Madrid is supported by its infrastructure, educational resources and a vibrant business landscape. José Manuel Ramos has another opinion on this topic. In his opinion, the production facility should be established on Tenerife Island, near Wooptix's headquarters and R&D facility, as well as close to the pool of talents from the university that the company originated from.

José Manuels biggest challenge was to find a solution for this disagreement. In the first meeting he gave the team the challenge to solve this problem and to provide him reasonable arguments for which of the two is the better option to set up production. Taking into account the circular economy focusses of the bootcamp, the team conducted a brainstorming session to map out possible ideas that can be proposed to the company letting them proceed further. While a lot of valid ideas were generated, one idea stood out especially. The idea of supporting the company to choose the right location viewed from a sustainable / circular economy perspective.

In the following discussion, detailed process steps were defined and evaluated. The team started by conducting a sustainability analysis while looking at the three pillars of sustainability – economic performance, social inclusiveness and environmental resilience. This process will be done simultaneously for the production location in Madrid, Spain and Tenerife, Spain.

## Results and Recommendations

In this chapter the research and results will be presented, starting with an introduction of the sustainability analysis. The analysis results will be presented, and the chapter will conclude with recommendations for the company regarding the stated problem.

### Introduction Sustainability

*(Author: Helge Gevekoth)*

Sustainability can be defined "as the balanced integration of economic performance, social inclusiveness, and environmental resilience, to the benefit of current and future generations" (Martin Geissdoerfer, 2017). Measuring the impact of these three points is also known as the concept of "triple bottom line" introduced by John Elkington (1997). The concept of this proposes that long-term success is not only relying on the profits and profitability, but also relies on people, the planet and the goal of maintaining viable social and economic franchise (Kleindoerfer et al., 2005). In the following the three pillars will be defined in more detail:

- Economic Performance (Profit)

Economic Performance measures the sales and profit of the company's operations. In addition, an often-used measurement are the taxes a company must pay per year. In general, these can be combined with the monetary flows of the company. The factor of created jobs is another important factor that is included in the economic view of the company (Savitz & Weber, 2006).

- Social inclusiveness (People)

Social inclusiveness describes the impact that the operation has on the stakeholders and the general community (especially nearby community). The main criteria measured are community impacts, labor practices, human rights, and product responsibility (Savitz & Weber, 2006).

- Environmental resilience (Planet)

Environmental resilience measures the impact operations have on the planet. Some examples that are measured are water quality, energy consumption, waste production, or air quality (Savitz & Weber, 2006).

After measuring every explained factor, a balanced scorecard or weighted factor analysis can be used to provide a comprehensive view of the organization's performance across all the three bottom lines.

**Economic Perspective**

*(Author: Mika Hansen)*

From an economic perspective, the group assesses how the decision about the production location might affect the factors sales, profit margin, taxes, and job creation. They are essential indicators for a sustainability analysis as they determine the financial viability and growth potential of any business. While sales evaluate access to customers and revenue generation, profit margins assess operational efficiency and financial returns. Taxes, on the other hand, influence the cost structure as well but also investigate how businesses can benefit from specific government policies. Finally, job creation fosters local economic development and reduces unemployment. In summary, the selected factors provide a holistic view of economic sustainability.

- Sales

Choosing a production location does not necessarily have a direct effect on Wooptix's sales since both producing on Tenerife and in Madrid would still allow them to serve customers around the world. However, the choice still might have some rather indirect effects. For example, Madrid might support trust-building with potential customers as it is generally acknowledged as a central business hub. Tenerife, on the other hand, might offer a unique branding opportunity ("Made in Tenerife"). However, these aspects are difficult to quantify. Easier to quantify are factors such as market size, proximity to key markets, and transport costs for exports. Since Wooptix's products are used in semiconductor manufacturing, the local market size does not really matter since it is a global industry with very few hubs around the world (i.e., Taiwan, South Korea, Japan, Netherlands, United States, China). No matter whether Wooptix decides to produce on Tenerife or in Madrid, their customers will be spread throughout the world. When it comes to proximity to key markets, Madrid has an advantage due to its proximity to the European semiconductor industry. Although Tenerife is somewhat close to both Europe and Africa, it is obviously further away from Europe than Madrid, and Africa is not considered a significant market for semiconductor manufacturing. An

advantage for Madrid can also be identified when looking at the transport costs associated with exports. In Madrid, the logistics infrastructure is way more sophisticated than on Tenerife, which leads to lower transport costs. Overall, Madrid is the advantageous choice from a sales perspective.

- Profit Margins

Profit margins are dependent on sales and costs. While sales were covered by the previous section, the cost structure will be analyzed in this one. Since it is once again difficult to obtain reliable figures, the factor will be approached by looking at cost-of-living and average wage rates. According to the cost-of-living index prepared by Numbeo, Tenerife ranks 322$^{nd}$ in the world. Compared to Madrid (ranked 167$^{th}$), the cost of living in Santa Cruz de Tenerife is 19.8% lower without rent and 24.4% lower including rent (Numbeo, 2024). At the same time, the average salary in Santa Cruz de Tenerife is 18.9% lower than in Madrid. While the average hourly rate in Santa Cruz de Tenerife is €15.50, it is €19.12 in Madrid (Salary Expert, 2024). These numbers clearly indicate that choosing Tenerife as the production location will lead to a beneficial cost structure. Therefore, Tenerife “wins” this category.

- Taxes

In 2000, the European Commission authorized the framework of the Economic and Fiscal Regime of the Canary Islands (REF) which includes a reduced corporate tax rate of 4% for companies in the Canary Islands Special Zone (ZEC). The general corporate tax rate that applies in the rest of Spain, including Madrid, is 25% (Klawters, 2023). Consequently, this category goes to Tenerife as well.

- Job Creation

When it comes to job creation, it can be anticipated that the setup of production in Tenerife will lead to a more significant local impact compared to Madrid. This is mainly due to the new opportunities in an economy with higher unemployment rates. Tenerife’s unemployment rate is 15.91% (European Parliamentary Research Service, 2024). In Madrid, on the other hand, there will be job creation benefits as well; however, they are likely to be less pronounced due to a more saturated labor market in the Spanish capital. The unemployment rate in Madrid is 9.72% (Statista, 2024).

In conclusion, Madrid offers advantages in terms of sales due to its proximity to the European semiconductor industry, established logistics infrastructure, and global business reputation. However, the analysis shows that Tenerife outperforms Madrid in terms of cost structure, tax benefits, and the potential for local job creation. From an economic perspective, Tenerife seems to be the preferred option when choosing a location for Wooptix’s production. The results are shown in Table 2.

*Table 2: Summary of the sustainability analysis (economic perspective)*

| Factor | Tenerife | Madrid |
|---|---|---|
| Sales | | |
| Profit Margins | | |
| Taxes | | |
| Job Creation | | |

## Social Perspective

*(Author: Mika Hansen)*

From a social perspective, the group assesses how the decision about the production location might affect the factors community impact, labor practices, human rights, and product responsibility. They are essential indicators for a sustainability analysis as they assess the ethical and societal implications of business decisions. While community impact focuses on contributions to local development and knowledge retention, labor practices ensure ethical treatment of employees. Respect for human rights strengthens social equity and corporate reputation. Finally, product responsibility highlights sustainable production and ethical standards. In summary, the selected factors provide a holistic view of social sustainability.

- Community Impact

Like the job creation category in the previous section, a positive impact on the community can be assumed for both Tenerife and Madrid. However, since the community in Madrid is already thriving, the impact on Tenerife's community is expected to be more pronounced. In the light of the circular economy nature of this year's blended intensive program, the group additionally wants to highlight the impact of what it calls "knowledge circularity." The technology behind Wooptix has been developed and improved by researchers from Tenerife. Locating the production outside of the island yields the risk of "brain drain", meaning that talent and expertise will be forced to leave the island. In interviews and conversations with various stakeholders on the islands, the group got an idea of how proud locals are that such state-of-the-art technology was developed on the island. Therefore, a continued and strong positive impact by fostering local innovation can be assumed in the case that production is set up on Tenerife. Based on those arguments, the island appears to be the preferred option from a community impact point of view.

- Labor Practices

In the profit margins category of the previous section, wages and cost-of-living were already analyzed. It could be seen that both factors almost offset each other, meaning that the buying power is roughly the same for people living on the island compared to Madrid although they earn significantly less. This is due to the lower cost of living on the Canary Islands. Other than that, both potential locations are subject to established

labor regulations, so that no major difference can be expected. In Madrid, Wooptix might face more severe labor competition challenges, but at the same time the accessible pool of talent is also much larger. In total, it is not possible to declare a winner in this category, so it will be considered a tie.

- Human Rights

Similar to the previous category, the human rights situation will be comparable, as both locations belong to the same country, so that human rights policies apply likewise. Again, this category will be considered a tie.

- Product Responsibility

From a product responsibility perspective, production on Tenerife yields the opportunity to design products with local sustainability narratives and ethical production practices. In Madrid, the narrative could rather be built around scalability and compliance with international standards. However, the quantification of such factors is difficult and not reasonably practicable within the scope of this report. Therefore, the category will be considered a tie as well.

It is in the nature of social factors that they are much more difficult to determine compared to economic factors, for example. While this also makes a conclusion of this section harder and, ultimately, less reliable, Tenerife emerges as the slightly stronger choice from the arguments provided in this section (see Table 3). This is primarily due to the island's potential for a more pronounced community impact. Establishing production on Tenerife supports local development and fosters "knowledge circularity," so that the talent and innovation rooted in Tenerife can be preserved.

*Table 3: Summary of the sustainability analysis (social perspective)*

| Factor | Tenerife | Madrid |
|---|---|---|
| Community Impact | | |
| Labor Practices | | |
| Human Rights | | |
| Product Responsibility | | |

## Environmental Perspective

*(Author: Helge Gevekoth)*

Comparing the two locations from the environmental perspective the team decided to analyze three main factors – pollution from transportation, energy, and waste management.

- Pollution from transportation

The main source of pollution next to energy production comes from inbound and outbound logistics. From the interview with Roberto Pangallo the main customer base was identified in Europe, although a large proportion of customers also come from abroad. The main suppliers are located in Germany, Finland and Japan. The following analysis examines the pollution associated with transportation between suppliers, Tenerife and customers, as well as between suppliers, Madrid and customers.

Tenerife is an Island located in the Atlantic Ocean and is therefore not connected to a big infrastructure. All resources that are not available on the island, components and other products must be imported. In Wooptix case none of the island's resources can be used in their production process. Furthermore, all components that are used to produce the products need to be shipped to the island by the suppliers. As this is only possible by ship or plane an environmentally friendly solution is unfavorable. Since these propose more $CO_2$ emissions than for example the transportation by train (Skrúcaný et al., 2018; Nusa & Kodak 2023). Madrid is well connected to the infrastructure of Europe. A production facility in Madrid is therefore more favorable to use the principle of freight consolidation (Campbell, 1990). The impact from this on pollution cannot be directly measured. Although, the infrastructure is developed transportation is done by Trucks which is one of the biggest polluting transportation modes (Skrúcaný et al., 2018; Nusa & Kodak 2023). On the other hand, many end customers are located nearby, minimizing the transportation distance and the need for extensive interchange between different transportation modes and thereby reducing the overall environmental impact.

- Energy

Since the energy usage is expected to be similar whether producing in Tenerife or Madrid, the analysis in this section focuses on the energy sources and the energy mix at the two locations.

In the past Tenerife depended solely on non-renewable energy sources – mostly diesel and oil, even though Tenerife has some excellent prerequisites for renewable energy production (Noronha, 2024). The island has about 2890 hours of sunlight per year and favorable wind probabilities (Weather and Climate, 2024). Today an average of 20% of Tenerife's energy is provided by renewable energy, consisting of 15% wind and 5% solar energy. This states that 80% of the energy is produced by burning oil resulting in an average of 763g of $CO_2$eg/kWh (Electricity Maps, 2023). Madrid is connected to the central Spanish energy grid. Therefore, the energy mix is a lot more varied than in

Tenerife. Today the grid consists of 53% regenerative energy. In addition, Spain generates about 76% of their energy with low $CO_2$. This is mainly due to the intensive use of Nuclear Energy. While this is beneficial for reducing $CO_2$ emissions, it poses additional environmental challenges for the storage of nuclear waste. In average the $CO_2$ emissions in the mainland Spain are 154g $CO_2$/kWh (Electricity Maps, 2023).

- Waste management

The exact amount of waste generated by the production process cannot be accurately determined at this time based on the available information. The more important question is whether the available waste management system focuses on recycling or on landfilling. Tenerife has its own waste management system and is relying on sorting waste by the citizens prior to the collection by companies. The trash is collected at the four main collecting stations where it gets compacted (Byrne, 2011). The disposal of unsorted waste or non-recycable trash relies mainly on the Arico landfill site (Medina, 2021). The landfill is secured for leachate. Recyclable materials are collected and brought to special recycling centers located on the island (Servicio Técnico de Desarrollo Sostenible). In conclusion the waste management system in Tenerife seems to be underdeveloped compared to European standards and is criticized (Medina, 2021). Madrid has an established waste management system, with the main waste treatment center located in the Valdemingómez Technology Park. The waste undergoes various advanced processes, including sorting, classification, and resource recovery. In 2023 about 91,1% were treated in the plant, this treatment includes recycling materials, exploiting the waste for energy or using the organic matter for producing biogas. Only 8,9% were directly transferred to the landfill located in the technology park (Valdemingómez Technology Park, 2023).

In conclusion Madrid can be seen as the clear leader from an environmental point of view as reflected in Table 4. Especially the energy production and the waste management of Madrid exceed the potential of Tenerife. Considering the transportation part, more intensive logistics are required for the island. However, the direct environmental impact is not directly measurable, as the final supply chains have not been identified. The introduction of hydrogen as a fuel for maritime transportation could potentially make the possible additional transportation distance neglectable.

*Table 4: Summary of the sustainability analysis (environmental perspective)*

| Factor | Tenerife | Madrid |
|---|---|---|
| Pollution from Transport | | |
| Energy | | |
| Waste Management | | |

## Conclusion

*(Author: Mika Hansen)*

The sustainability analysis evaluated the economic, social, and environmental implications of Wooptix's decision to establish their production site on either Tenerife or in Madrid.

From the economic perspective, Tenerife can be regarded as the more favorable option due to the superior cost structure, significant tax incentives, and the potential for local job creation. From the social perspective, Tenerife emerges as the preferred choice as well. While this perspective is much more balanced, Tenerife outperforms Madrid in its potential for community impact and the preservation of local talent and innovation through "knowledge circularity." Finally, from the environmental perspective, Madrid appears to be the preferred option. The Spanish capital provides superior energy production capabilities, advanced waste management systems, and reduced transportation requirements.

Table 5 summarizes the findings of the sustainability analysis. If all three perspectives are given equal weight, Tenerife presents itself as the preferred location for establishing a production site. However, the final decision will depend on how Wooptix's management prioritizes these perspectives. The subsequent section Discussion and Next Steps offers a discussion on the results and provides a potential outlook from the group's perspective.

*Table 5: Summary of the sustainability analysis*

| Perspective | Tenerife | Madrid |
|---|---|---|
| Economic | | |
| Social | | |
| Environmental | | |

## Discussion and Next Steps

*(Author: Max Engel)*

**Answering the question?**

Our team was commissioned by José Manuel Ramos, CEO of Wooptix, to investigate the location advantages of Tenerife in comparison to Madrid. Ramos assigned us this task because a significant investor in Wooptix is considering future production in Madrid. However, for various personal reasons, Ramos prefers that the production be established in Tenerife. To achieve this, Chapter 3.4.4 compares the two locations using a sustainability analysis, enabling an objective conclusion to be drawn as to whether Madrid or Tenerife is the more suitable location for a circular economy. Table 4 “Summary of the sustainability analysis” provides a concise overview of the sustainability analysis results, indicating that Tenerife has advantages in two out of three categories compared to Madrid. The final decision will be made by the management team. This analysis is intended to provide general guidance and a comprehensive overview of the two locations within the three categories. Ultimately, this analysis provides the management team at Wooptix with a valuable decision-making tool.

The objective of the sustainability analysis is to objectively compare the two locations based on a set of selected criteria. The objective was to determine which of the two locations was more suitable for a circular and sustainable production process. José Manuel Ramos's task was to produce a report that did not provide a detailed analysis of the advantages and disadvantages of the two locations. Instead, it was to list and describe the advantages of Tenerife in comparison to Madrid.

The initial assignment given to our team by Ramos has not been fully completed. While the sustainability analysis presents some advantages of Tenerife over Madrid, it also identifies disadvantages of Tenerife. This was, however, an intentional aspect of the analysis. The objective was to conduct an objective analysis of both locations to identify the optimal location for a circular production facility.

**Initiatives for a more regenerative economy:**

The following section outlines further measures and steps that will contribute to achieving a higher level of sustainability in line with a regenerative economy.

1. Tenerife is an ideal location for the expansion of renewable energies, offering optimal climatic conditions and a strategic position for the development of solar and wind power. The island's climate, with more than 2,890 hours of sunshine per year (Wheather and Climate, 2024), makes it an ideal location for solar energy initiatives. Further investment in new infrastructure for renewable energies – such as large solar parks or even small wind turbine installations, as exemplified by Wooptix – would assist the company in achieving its planned production output with a higher proportion of green electricity. This is an initial step towards a more sustainable economy, with subsequent steps also capable of achieving a level of regeneration.

2. Adoption of Circular Economy Principles: The objective of Wooptix is to achieve a reduction in waste, an extension of product life cycles and an increase in resource efficiency through the application of the principles of the circular economy. The following key activities could be carried out: Wooptix should introduce take-back programmes for used products, with a view to recycling or, ideally, reusing them. In order to reduce our environmental impact, we should switch to using biodegradable packaging materials instead of single-use items. Partnerships with local recycling companies will ensure the reuse of materials wherever possible. Such initiatives would not only improve environmental impact but also form the basis for a regenerative economy (Ellen MacArthur Foundation, 2021).

3. Sustainable Supply Networks:
By optimising logistics, significant reductions in emissions can be achieved. Given that Madrid already has the infrastructure in place to support freight consolidation and efficient transport systems, Tenerife could also benefit from environmentally friendly transport solutions such as hydrogen-powered ships to offset the environmental impact of its geographical isolation. Furthermore, collaboration with environmentally conscious suppliers could ensure that sustainability is extended throughout the entire value chain (United Nations, 2020).

4. Local Community Engagement:
To enhance Wooptix's reputation, it is crucial to collaborate closely with local institutions and provide long-term support for sustainable initiatives in the community. Educational programmes and collaborations with institutions such as the University of La Laguna could facilitate the development of a local talent pool with a focus on sustainability. It would be beneficial to utilise the network of José Manuel Ramos, a university professor, in this particular instance. Such partnerships facilitate the training of qualified professionals on the island, while also positioning Wooptix as a driving force for economic and social development in Tenerife (University of Virginia, 2024).

5. Transparent Reporting:
Regular sustainability reports are essential for monitoring and communicating Wooptix's progress. The publication of key performance indicators, such as $CO_2$ emissions, waste reduction and community engagement, reinforces investor confidence and signals a commitment to continuous improvement. Such reports facilitate the visibility of the company's accountability and facilitate the establishment and enhancement of long-term relationships with partners and investors (Global Reporting Initiative, 2021).

6. Focus on Research and Development:
In the sustainability analysis, Tenerife only loses out to Madrid in the Environment category. The main reason for this is that Tenerife is cut off from the mainland.
A simple way to limit this negative impact on Tenerife would be to limit the scale of production. This is because the negative environmental impact is proportional to the number of parts produced. Small batch sizes have a minimal environmental impact. This challenge could be solved by developing Tenerife as a center for software,

research and development, while building only a small prototyping production line in Tenerife. This would allow the first products to be manufactured in Tenerife and a large production facility to be established in the center of Europe if the demand were to increase. Tenerife could benefit from the positive impact in the categories of economic and social benefits, while keeping the negative environmental impact to a minimum.

By adopting the recommended strategies of expanding renewable energy, adopting circular economy practices, optimizing supply chains, increasing local engagement in the community and increasing transparency, Wooptix will be able to gain a competitive advantage while fostering sustainability. Its proactive approach to industry challenges related to social, environmental, and economic issues may set a benchmark for others in the industry to prove how businesses can thrive while contributing to a regenerative economy.

## 3.5. PISCES VI

### Company Overview

*(Author: Abhishek Kumar)*

Pisces VI Submarine SL is a pioneering entity in the realm of deep-sea exploration, enhancing both accessibility and affordability. Established in the United States in 2015, the company transitioned its operations to Tenerife, located in the Canary Islands, Spain, in 2020.

**Company Origins**

Pisces VI can be traced back to Scott Waters, an entrepreneur driven by a fervent interest in underwater exploration. After completing his inaugural submarine project, Founder & CEO Scott aimed to concentrate on vehicles tailored for hazardous environments. This pursuit led him to Pisces VI, a spherical submersible with a notable legacy originating from the Cold War period.

**Key Milestones**

1. **1976:** The construction of Pisces VI was undertaken by the International Hydrodynamics Corporation (HYCO) in Vancouver, Canada.
2. **1979:** After HYCO's financial collapse, Pisces VI was acquired by International Underwater Contractors.
3. **1986:** The submarine was reactivated for a National Geographic expedition, significantly advancing our understanding of six-gilled sharks.
4. **2015:** Scott Waters acquired Pisces VI from International Underwater Contractors and founded Pisces VI Submarine LLC.
5. **2017:** Scott identified Tenerife as a potential operational base for the submarine.
6. **2019:** The company relocated to Canada to conduct preparations for sea trials.
7. **2020:** Pisces VI Submarine SL established its headquarters in Tenerife, Canary Islands.

**Why Tenerife?**

The selection of Tenerife as the company's operational hub was a strategic decision influenced by multiple factors:

1. The presence of a volcanically active archipelago
2. Proximity of deep waters to the coastline
3. Distinct geological and biological attributes

4. Unique geomorphological, oceanographic, and climatological features
5. A robust network and collaboration opportunities with local research institutions and universities

Additionally, Tenerife's reputation as a premier tourist destination—ranking 3rd in Spain, 11th in Europe, and 24th globally, with over six million visitors annually—offers a solid infrastructure to support the company's activities.

**Business Model**

Pisces VI Submarine SL has established a distinctive business model aimed at facilitating affordable access to deep ocean exploration. The company's strategy is comprehensive, addressing a variety of sectors and requirements:

*A. Multifunctional Deep-Sea Operations*

The Pisces VI submarine is capable of descending to depths of 2,180 meters (7,155 ft), making it ideal for an array of underwater activities. This adaptability enables the company to cater to a diverse clientele, including scientific researchers, filmmakers, and adventurers.

*B. Economical Mobility*

A notable feature of Pisces VI is its design, which allows it to be housed within a standard shipping container. This characteristic significantly lowers transportation and operational expenses, facilitating efficient global deployment of the submarine.

*C. Tailored Services*

The engineering and fabrication team at Pisces VI can modify the submarine to fulfill specific project requirements. This adaptability allows the company to address a wide range of underwater activities, from scientific investigations to exploration and filming.

*D. Environmentally Responsible Operations*

Pisces VI employs seawater as ballast rather than steel weights, enabling it to function in marine protected areas and sensitive ecosystems without causing environmental harm.

*E. Strategic Operational Base*

Based in the Canary Islands, Pisces VI conducts missions worldwide before returning to its home base. This strategy optimizes costs and takes advantage of the region's unique geological and oceanographic characteristics.

*F. Technology Transfer*

The company has been recognized for its role in transferring technology and innovation to the Canary Islands and Spain, a designation that may create additional revenue opportunities and partnerships.

*G. Varied Clientele*

Pisces VI caters to a diverse array of clients, which includes:

1. Government agencies aiming to enhance scientific research without the financial strain of comprehensive operations
2. Filmmakers in need of underwater cinematography
3. Search and recovery operations
4. Clients involved in high-stakes adventure tourism

### *H. Enhanced Mission Capabilities*

With a standard mission duration of 8 hours (extending up to a maximum of 14 hours) and the ability to accommodate one pilot along with three passengers, Pisces VI is well-equipped to meet a variety of research and exploration requirements.

In summary, Pisces VI Submarine SL has developed a business model that effectively connects advanced scientific research with accessible adventure tourism. By providing cutting-edge technology, operational adaptability, and economical solutions, the company has established itself as a crucial resource in the exploration of the underwater realm, serving a wide range of clients and enhancing our comprehension of the deep sea.

## Current Status of the Company

*(Author: Moritz Bruttel)*

Given the difficulty of preventing the use of raw materials, a variety of approaches have been developed to implement a circular economy and reduce resource consumption. The UNCTAD, for instance, advocates a strategy based on Reduce, Recycle, Remanufacture and Reuse. These approaches can be applied to specific products and, in some cases, combined during the product life cycle. In essence, the circular economy is about extending the lifespan of products and reducing the amount of waste and emissions generated during that process (European Parliament, 2023).

The date of 20 May 2024 demonstrates the crucial need for integrating circularity into the economy. This was the day of the current calendar year on which global human demand for renewable resources exceeded the Earth's capacity to regenerate these resources in the current year. This is also known as Earth Overshoot Day. Even though many less developed countries have significantly lower resource consumption, we are currently exceeding the capacity of approximately 1.75 Earths. This indicates that we are utilizing the resources of the Earth beyond its regenerative capacity. Therefore, it is of paramount importance to reduce resource consumption in all forms (EOD, 2024).

To be able to analyze and understand the current situation of the company, we will take a closer look at the three pillars of sustainability. In order to be able to fit them into the RESTORE model.

### Environment

As Pisces VI's business model does not involve production processes, it is relatively difficult to adequately present the environmental perspective. However, as in most companies it is the raw materials and energy sources that play the biggest role in environmental sustainability, these will be considered in the following.

The submarine itself is electrically powered by a 40-kWh battery. Spain already has a 53% share of renewable energy in its electricity mix in 2023 (Lucía Fernández, 2024), which is very advanced by European standards. The electricity used therefore has a relatively low CO2 footprint. The company currently makes around 20 dives per year, and assuming that one battery charge is used per dive, this equates to an annual electricity consumption of 800-kWh. For comparison: In Spain, per capita electricity consumption in 2023 will be just under 5,100-kWh (V. Pawlik, 2024). This shows that although pure electricity consumption has a negative impact, it is very small for a company.

It is also interesting to analyze the company's material flows, as technical components or components with a high degree of vertical integration usually have a high carbon footprint. Starting with the submarine itself, which was built in Canada in 1976 and only purchased by the founder of Pisces VI in 2015, it has since been restored and modernized (PiscesVI, 2024). The submarine itself is a prime example of circular economy, as the hull has been reused and even upgraded. Of course, the submarine also has technical components that wear out. However, these are repaired and maintained by the company's own engineering team, as this special technology is generally very expensive. Thus, the material flows do not contribute significantly to the environmental impact.

### Economy

When considering economic sustainability, the main issue is whether a company can satisfy market needs efficiently, has innovative potential and can be successful in the long term.

In the case of Pisces VI, it is of particular interest to take a closer look at the efficient satisfaction of market needs, as the company is currently still far from its capacity limit. A major advantage of the company is that both the submarine and all the equipment required for a mission fit into just two sea containers and can therefore be shipped very easily. This is a major competitive advantage and a very innovative solution, particularly in terms of logistics costs and mobility. In terms of innovation potential, it is a little more difficult to say, as the original business model is not based on innovation, but on safety and reliability. Nevertheless, Pisces VI has the potential to drive and test innovation in the field of deep-sea technology.

Its weakness, however, lies in securing long-term success, as the business model itself requires high investment costs and offers only a limited customer base, especially if, like Pisces VI, it adheres to its own moral standards and generally excludes areas such

as deep-sea mining. This is therefore the greatest weakness of the sustainability concept to date.

**Social**

The social sustainability of a company covers many areas. From the basics such as equal opportunities to cooperation and creating value for society.

The basic social sustainability factors are met by the company as a matter of course, so it is more interesting to focus on the long-term issues related to value creation. However, it is worth highlighting the company's corporate culture, which has a strong focus on sustainability and social justice. In particular, exploration missions, which aim to explore and conserve the oceans, create social value by generating knowledge and data. The company is therefore very well positioned from a societal perspective.

**Classification**

Our detailed analysis has shown that PISCES VI has hardly any negative impacts. The resources consumed are far too small, especially when compared to the added value provided by the company, namely the collection of information and data on a barely explored underwater world. For this reason, the conventional and green categories can be excluded, as these two levels have a significant negative impact on the environment.

To be classified as Restorative or even Regenerative, it is necessary to make a positive contribution to the climate and to restore damaged systems.

The company's classification as sustainable is therefore relatively clear and reflects the current situation. Given its very positive corporate culture, PiscesVI certainly still has a lot of potential.

## Research Focus

*(Author: Emiliya Tamashevich)*

**Context of the Company's Question**

Pisces VI Submarine plays a unique role in advancing deep-sea exploration, providing access to depths that might be unreachable by conventional methods with the purpose of science and data collection, deep ocean tourism, media and film production, education and consultation, archaeology and recovery, industry work and inspection (Pisces VI Submarine, 2023). Their work aligns with a growing global emphasis on understanding and conserving marine ecosystems, which are critical to addressing climate change and biodiversity loss (BMT, 2023). This commitment is particularly important as the deep sea remains one of the least explored environments on Earth yet holds immense potential for discoveries that can inform sustainable ocean management (Costello & Chaudhary, 2017; Seascape Ecology Lab, 2020).

Pisces VI focuses on integrating circularity and sustainability into its business model, aiming for more environmentally friendly practices. Circularity emphasizes reducing

waste and extending resource lifecycles to minimize negative environmental impact while maximizing economic value and profit. In the field of manned submersibles, being sustainable is very important. Not only is it the ethical thing to do, but it is also essential to maintain a competitive edge. Companies that prioritise sustainable practices have a better chance of attracting funding, forming key partnerships and winning long-term contracts. In this environment, a focus on sustainability is critical to business success.

As a result, like many companies in the sector, Pisces VI faces challenges such as insufficient funding, limited access to profitable partnerships and a brand image that doesn't fully convey its unique value. These challenges make it difficult for the company to consistently win contracts, which are essential to ensure steady cash flow and investment in sustainable practices. Without a reliable stream of contracts, the company struggles to maintain financial stability and support its efforts to become more sustainable. Addressing these challenges requires a holistic approach that combines technological innovation, effective communication of value and alignment with global sustainability goals (BMT, 2023).

In addition, the company operates within a larger ecosystem where circularity and sustainability are increasingly seen as essential to gain credibility and drive growth. For example, initiatives such as The Ocean Decade highlight the importance of building skills and collaborating on research to manage marine ec
osystems sustainably. Such frameworks underscore the importance of partnerships with academic, governmental, and private entities to advance innovation while reducing environmental impacts (Howell et al., 2020). Therefore, Pisces VI's question to the CIB program was centred on identifying actionable strategies to enhance its circularity and sustainability while maintaining growth and profitability.

**The Challenges Pisces VI Faces**

Pisces VI faces several interrelated challenges that are limiting its sustainable growth and wider impact. These challenges include:

1. **Lack of stable revenue streams**
   One of the problems for Pisces VI is the lack of a consistent and reliable source of income. This makes it hard for the company to keep running smoothly, invest in new equipment and technologies, and establish a stable financial future. For companies in competitive industries, it's important to have different revenue streams. This helps them deal with financial instabilities and grow their business.

2. **Limited funding opportunities and challenges in applying for funding**
   Accessing grants, and other sources of funding is a major challenge for Pisces VI. Grant writing is a resource-intensive process that requires expertise and time that organisations may not have. In addition, funding for niche sectors such as deep-sea exploration is highly competitive and requires innovative approaches to stand out.

3. **Lack of long-term partnerships and contracts**
   Building stable partnerships is essential for long-term viability. However, Pisces VI is struggling to secure lasting collaborations with academic institutions, conservation organisations or private entities. These relationships could provide essential resources, funding and shared expertise.

4. **A brand image that doesn't effectively communicate unique value**
   Despite its potential, Pisces VI has yet to effectively communicate its advantages over competing technologies, such as underwater robotics. This gap limits its ability to attract investors, partners and wider public interest. A strong brand identity can foster trust and recognition, which are essential for attracting funding and collaboration.

These challenges are deeply interlinked. For example, an unclear brand identity makes it harder to attract partnerships and grants. Without sufficient funding, the organisation cannot invest in marketing or infrastructure that would strengthen its brand or enable collaboration. This creates a cycle that limits the organisation's ability to grow and adopt sustainable and circular practices. By addressing these issues through a cohesive strategy, Pisces VI has the potential to transform into a regenerative and thriving business model.

**The Company's Main Question**

Pisces VI centres on achieving sustainable and steady growth while overcoming existing challenges. Therefore, the general question the company seeks to address is:

*"How can we create a circular and sustainable business model that supports steady growth, secures funding, builds partnerships, and enhances our brand?"*

This question reflects the core issues faced by the company and highlights the importance of transitioning toward a regenerative economic approach. Circularity and sustainability are essential in achieving these goals, especially in niche industries such as deep-sea exploration, where resource constraints and environmental considerations are critical.

To achieve its goal, the challenge may be broken down into three sub-questions:

1. **How to secure consistent funding and attract grants?**
   Sustainable growth requires a dependable financial base, yet Pisces VI struggles with the complexities of grant application processes and the competitiveness of securing public and private funding. Addressing this means developing structured approaches to funding, including creating templates for applications, hiring grant advisors, and pursuing diverse funding opportunities.

2. **How to establish long-term, profitable partnerships?**
   Collaboration with academic institutions, environmental organisations and the private sector is essential for long-term success. Pisces VI faces difficulties in forging relationships that are mutually beneficial and enduring. Leveraging

strategic partnerships can provide access to resources, shared expertise, and broader public support.

3. **How to enhance the company’s brand image to clearly communicate its value?**
   A strong and clear brand image is crucial to distinguishing Pisces VI from competitors. The company's current brand does not effectively highlight its unique capabilities in ocean exploration. Improving the brand would involve targeted marketing, highlighting the societal and environmental value of its work, and aligning messaging with stakeholder priorities.

Answering these questions is crucial for Pisces VI to move from a business model that relies on occasional funding and temporary projects to one that is stable and forward-looking. A regenerative approach, where funding supports partnerships, partnerships enhance the brand, and a strong brand attracts further funding, is key to the company’s long-term success. These interconnected goals emphasize the need for an integrated solution that aligns financial, operational, and environmental objectives.

## Results and Recommendations

*(Author: Sara Rahouli)*

Pisces VI is well-positioned to address key challenges such as funding limitations, insufficient brand visibility, and the need for long-term partnerships. This roadmap outlines actionable recommendations and their expected results, categorized into short-term and long-term strategies. These initiatives aim to secure immediate stability and sustained growth while aligning with global goals such as SDG 14 (Life Below Water).

### Short-Term and Mid-Term Strategies

The short-term recommendations aim to address immediate challenges, secure quick wins, and lay the foundation for sustainable operations.

- *Optimize Grant Application Processes*

Pisces VI could benefit significantly by improving its grant application processes to enhance efficiency and increase the likelihood of success. One strategy could be partnering with institutions that have existing experience in securing grants, creating a mutually beneficial relationship. This would allow Pisces VI to leverage the expertise of these organizations while also providing them with valuable contributions to their own projects.

Another option is to hire master's-level working students with expertise in fields related to grant writing and application processes. These students could be trained to handle the technicalities of grant proposals, improving the organization's submission quality. Alternatively, hiring experienced consultants in grant writing can also ensure professional and impactful submissions.

To streamline the application process, Pisces VI should focus on developing reusable templates for recurring funding opportunities. This will save time and ensure consistency in submissions. Platforms like ProposalCENTRAL, Fluxx Grantmaker, and OpenGrants can be utilized to track deadlines, manage applications, and maintain an organized workflow.

By implementing these strategies, Pisces VI can significantly enhance its grant application success, ultimately gaining financial support from major organizations like UNDP, Horizon Europe, and The Ocean Foundation.

*Table 6: Recommendations for Improving Grant Success*

| Recommendation | Tools/Partners | Expected Results |
|---|---|---|
| Train staff or hire consultants and-or working students | ProposalCENTRAL, OpenGrants. | Improved grant success rates |
| Develop reusable templates | Internal expertise | Standardized applications for recurring opportunities |

- *Boost Brand Visibility*

Pisces VI should enhance its visibility by creating engaging digital content that tells the story of its development into a state-of-the-art exploration tool. This content should emphasize the company's contributions to ocean sustainability and conservation, highlighting its impact in a way that resonates with a broad audience. To maximize reach, dissemination should focus on social media platforms such as Twitter, Instagram, and LinkedIn, as well as through strategic partnerships with institutions like the Monterey Bay Aquarium. Although based in California, the Monterey Bay Aquarium's global reputation for marine conservation and its extensive network can help amplify Pisces VI's mission. A partnership with such an esteemed institution could also open opportunities for joint research expeditions, conservation initiatives, and educational programs, particularly in regions like Tenerife, where Pisces VI could showcase its technology in deep-sea exploration and marine research. Additionally, organizing public exhibitions or events in key locations would allow Pisces VI to display the submarine's missions and technologies, fostering direct engagement with the public, researchers, and potential funders. This approach is expected to boost global recognition of Pisces VI's capabilities, build stakeholder confidence, and enhance public trust in the company's mission.

*Table 7: Recommendations for Improving Brand Image*

| Recommendation | Tools/Partners | Expected Results |
|---|---|---|
| Develop digital storytelling content | Social media platforms | Enhanced global visibility and stakeholder engagement |
| Host exhibitions or public events | Monterey Bay Aquarium, event venues | Increased awareness and understanding of Pisces VI's technology and missions among researchers, funders, and the public |
| Partner on joint projects (e.g., Tenerife initiative) | Monterey Bay Aquarium, Pisces VI | Increased global recognition, expanded research opportunities, and stronger partnerships in marine conservation |

- *Expand Market and Operational Presence*

Pisces VI should increase its participation in high-profile international events, such as the UN Ocean Conference 2025, to showcase its achievements in marine technology, sustainability, and ocean conservation. These events provide an ideal platform for the company to demonstrate its cutting-edge submarine technology, along with its contributions to marine research and environmental protection. In addition to participating in global conferences, Pisces VI should organize large-scale exhibitions that specifically showcase its submarine technology, research capabilities, and innovations in ocean sustainability. These exhibitions would be targeted at attracting potential partners, investors, and clients, offering a chance to display the company's unique solutions and value propositions to a wider audience. By expanding its presence at such events, Pisces VI can strengthen global partnerships, broaden its network, and significantly increase its market visibility. This expanded presence will not only enhance the company's reputation but also create new business opportunities, strategic alliances, and investment, driving long-term growth and positioning Pisces VI as a leader in the marine technology and sustainability sectors.

*Table 8: Recommendations for Improving Market Expansion*

| Recommendation | Tools/Partners | Expected Results |
|---|---|---|
| Participate in global conferences | UN Ocean Conference 2025 | Increased visibility on the global stage, showcasing Pisces VI's innovations and achievements, leading to new collaborations and partnerships in marine research and technology. |
| Host large-scale exhibitions | Industry stakeholders, potential investors, clients | Exhibitions showcasing Pisces VI's submarine technology, marine research capabilities, and contributions to ocean sustainability. This will help attract new partners, investors, and clients, expanding market reach and business opportunities. |

- *Collaboration with Local Institutions*

Pisces VI could establish partnerships with universities and research organizations based in Tenerife through various collaborative initiatives. For example, they could co-host workshops and seminars on ocean sustainability, deep-sea exploration, and marine technologies, inviting both academic experts and students to participate. These events could serve as platforms for sharing knowledge and fostering collaboration between Pisces VI and local researchers. Additionally, Pisces VI could create internship programs or research challenges where students work alongside their team, gaining hands-on experience in ocean exploration technology or data analysis. Collaborative research projects, such as studying local marine ecosystems or conducting environmental impact assessments using Pisces VI's advanced technologies, could further strengthen ties. By involving students and researchers in real-world applications, Pisces VI can contribute to the academic community while also benefiting from fresh ideas and insights. These efforts would not only enhance Pisces

VI's credibility within the academic sector but also promote innovation and establish long-term, mutually beneficial partnerships with Tenerife-based institutions.

*Table 9: Recommendations for Improving Collaborations*

| Recommendation | Tools/Partners | Expected Results |
|---|---|---|
| Establish joint research programs | Tenerife universities, local research organizations | Stronger academic partnerships and collaborative research opportunities, which can lead to innovative solutions and further academic recognition for Pisces VI. These partnerships provide opportunities for knowledge exchange and access to academic expertise. |
| Offer internships and workshops | Local research institutions, Tenerife-based universities | Increased student engagement and credibility in academia by providing hands-on experience and fostering future talent. This creates a pipeline for long-term collaboration and strengthens Pisces VI's reputation as a leader in marine technology and research. |

- *Monetize Existing Technologies*

While Scott Waters, the CEO of Pisces VI, has clarified that leveraging proprietary technologies through leasing or selling components is not his primary focus, it still plays an important role in the company's broader strategy of circularity and business sustainability. By leasing or selling components such as deep-sea lighting systems and exploration tools, Pisces VI can generate additional revenue without compromising its core operations. Securing patents for these innovations would allow the company to license its technologies to other industries, such as oil and gas, marine research, or entertainment, expanding its market reach. While not the central focus, this approach contributes to financial sustainability by diversifying income streams, reducing reliance on external grants, and supporting the company's long-term operational costs. Ultimately, this strategy aligns with Pisces VI's commitment to circular business practices and enhances the overall sustainability of the company.

*Table 10: Recommendations for monetizing existing technologies*

| Recommendation | Tools/Partners | Expected Results |
|---|---|---|
| Lease or sell components | Marine research organizations, engineering, oil and gas industries | Generating recurring income through leasing or selling technologies, contributing to business sustainability without detracting from the company's primary focus. |
| Patent and license technologies | Marine research, engineering, and entertainment industries | Diversify funding sources by licensing patented technologies, reducing dependency on external grants and supporting the company's circularity and long-term financial health. |

### Long-Term Strategies

The long-term strategies aim to ensure sustainability, establish Pisces VI as a global leader in marine exploration, and contribute to innovation in ocean conservation.

- *Deepen Circular Economy Integration*

Pisces VI already applies the approach of refurbishing and modernizing submarine components, particularly due to the high cost of purchasing new parts, as confirmed in an interview with David Barral Diez, the Senior Engineer & Operations Manager at Pisces VI. To further enhance this practice, Pisces VI could collaborate with initiatives like the EU Blue Economy Projects, which focus on sustainability and innovation in marine industries. Although these projects may not have direct expertise in submarine parts, they offer valuable insights into sustainable marine technologies, recycling, reusing, and reducing waste. These initiatives provide access to a network of experts and resources in marine engineering and environmental impact, which could help Pisces VI refine and expand its existing refurbishment practices. Collaboration could also bring Pisces VI into contact with cutting-edge technologies and sustainable design approaches that could be applied to its operations, such as more efficient materials management and advanced recycling techniques. Additionally, the EU's focus on sustainability could open doors to funding opportunities or partnerships with other organizations pursuing similar goals. By working with the EU Blue Economy Projects, Pisces VI can stay competitive, reduce its environmental footprint, and enhance its reputation as an environmentally responsible organization committed to the circular economy.

*Table 11: Recommendations for integration of circular economy strategies*

| Recommendation | Tools/Partners | Expected Results |
|---|---|---|
| Modernize submarine components | EU Blue Economy Projects, marine engineering experts, local research institutions | Reduced waste and extended component lifecycle by applying sustainable practices and leveraging innovative recycling technologies. |
| Explore recycling opportunities | Marine technology innovators, EU-funded sustainability initiatives | Strengthened sustainability leadership by implementing cutting-edge recycling methods and optimizing component refurbishment processes. |

- *Establish Long-Term Funding Partnerships*

Pisces VI should strategically deepen its long-term relationships with key funding organizations like UNESCO's Intergovernmental Oceanographic Commission (IOC), the Global Environment Facility (GEF), and the Blue Action Fund. These organizations are pivotal in supporting marine research and conservation, and securing their backing will provide Pisces VI with the recurring, stable financial resources necessary for sustained growth. Since Pisces VI already has a Business Development Manager, this role can be expanded by incorporating specialized expertise in investor relations. The

focus should be on creating tailored communication strategies to engage with each funding body, highlighting Pisces VI's specific contributions to ocean sustainability, technology innovation, and environmental impact. Moreover, Pisces VI could host regular briefings, provide detailed progress reports, and align its goals with the priorities of these funding organizations to ensure long-term alignment and mutual benefit. By actively cultivating these relationships and demonstrating impact, Pisces VI can secure continuous support for its operations and research without the need for constant fundraising efforts. This approach would enhance Pisces VI's financial stability and establish it as a trusted partner in the global marine conservation community. (For a list of potential long-term partnerships, please refer to Appendix A)

*Table 12: Recommendations for establishing long-term partnerships*

| Recommendation | Tools/Partners | Expected Results |
|---|---|---|
| Develop recurring partnerships | UNESCO IOC, GEF, Blue Action Fund, marine research organizations | Establishing stable, long-term financial support through recurring partnerships, which will enable Pisces VI to secure the necessary resources for sustained growth and long-term operational and research initiatives. This ensures financial stability and reduces reliance on ad-hoc funding efforts. |
| Appoint investor relations manager | In-house expertise, Business Development Manager | Strengthening communication and building trust with key funding bodies, ensuring consistent financial support. This will improve Pisces VI's ability to maintain strong relationships with stakeholders, enhancing credibility and securing ongoing backing for future projects. |

- *Advance Research and Innovation*

Pisces VI is not only focused on providing submarine services but aims to play a significant role in broader exploration and research efforts, as emphasized by Scott Waters, the Founder & CEO. The company envisions itself as an active contributor to deep-sea exploration, environmental monitoring, and scientific discovery, particularly in the unique marine environment around Tenerife. This ambition opens up several avenues for collaboration and innovation, allowing Pisces VI to integrate its technologies into more comprehensive, interdisciplinary research initiatives.

For instance, collaborating with marine biologists could involve studying the rich biodiversity of the waters around Tenerife, a hotspot for marine life, where Pisces VI's submersibles could explore species and ecosystems that remain largely unexplored. Working with marine geologists could enable Pisces VI to study the volcanic underwater features surrounding Tenerife, such as submerged volcanoes and seafloor vents, offering valuable insights into the region's geological history. Furthermore, partnerships with environmental scientists could focus on monitoring the impact of climate change on the local marine ecosystem, using Pisces VI's technology to collect high-resolution data on temperature shifts, acidity, and marine health in real time.

To support these initiatives, Pisces VI could establish long-term internship and research programs with local academic institutions in Tenerife, such as the University of La Laguna, further fostering interdisciplinary collaboration. These programs could engage students from marine biology, geology, oceanography, and environmental science, providing them with practical experience while driving innovation in deep-sea exploration. The research could lead to the development of new materials, energy-efficient systems, or advanced sensors tailored to the specific needs of the region's unique marine environment.

However, securing consistent funding remains a challenge, which is where circularity comes into play. By fostering strong partnerships with local academic institutions, research organizations, and global funding bodies like the Global Environment Facility (GEF), Blue Action Fund, or Horizon Europe, Pisces VI can unlock sustainable funding for these interdisciplinary projects. These collaborations could result in successful grant applications for marine research and conservation efforts, particularly those focused on the waters around Tenerife. For instance, funding could be directed toward projects examining the effects of climate change on the island's marine biodiversity or advancing sustainable deep-sea exploration technologies.

The funding received from these collaborations can be reinvested into further research and technological development, ensuring Pisces VI continues to innovate and lead in marine exploration. As Pisces VI's technological capabilities improve and its research initiatives expand, its reputation as a leader in marine exploration and environmental sustainability will grow. This, in turn, will make it easier to secure additional funding, forming a self-sustaining cycle of partnerships, funding, and technological advancement. This circularity of strong relationships, successful grants, and reinvestment in technology will ensure that Pisces VI remains at the forefront of deep-sea exploration in Tenerife and beyond, contributing to scientific discovery and maintaining long-term financial stability and growth.

*Table 13: Recommendations for advancing research and innovation initiatives*

| Recommendation | Tools/Partners | Expected Results |
|---|---|---|
| Collaborate on technology development | Academic institutions, marine research organizations, University of La Laguna | Development of breakthrough innovations in deep-sea exploration, including advanced sensors, sustainable materials, and energy-efficient technologies, specifically designed to address the unique challenges of Tenerife's marine environment. This will position Pisces VI as a leader in marine technology research and contribute to scientific advancements in ocean exploration. |
| Launch internship programs | Universities, research bodies, University of La Laguna, marine biology and geology departments | Enhanced expertise and knowledge transfer through hands-on experience for students and researchers, fostering the next generation of marine scientists and engineers. These programs will help build a pipeline of talent, support innovation, and ensure continuous development of new solutions for deep-sea exploration and sustainability efforts. |

### Implementation Framework

The implementation framework ties together the key recommendations and expected results, providing clear actions and outcomes at each stage. The short-term phase focuses on laying the foundation, while the mid-term and long-term strategies build on these foundations to ensure continuous growth, financial sustainability, and leadership in marine research and technology.

*Table 14: Implementation Framework*

| Timeline | Action Items | Expected Outcomes |
|---|---|---|
| **Short-Term (0–2 Years)** | ▪ Establish participation in global conferences (e.g., UN Ocean Conference 2025).<br>▪ Develop partnerships with academic institutions for joint research.<br>▪ Launch internship programs for students in marine technology and research.<br>▪ Foster early-stage collaborations with funding bodies (e.g., GEF, Blue Action Fund). | ▪ Increased visibility and brand recognition globally.<br>▪ Initial partnerships formed for technology development.<br>▪ Knowledge transfer through internships.<br>▪ Secured initial funding and grants for research projects. |
| **Mid-Term (2–5 Years)** | ▪ Host large-scale exhibitions showcasing Pisces VI's achievements and technologies.<br>▪ Strengthen partnerships with universities and research bodies.<br>▪ Develop and implement co-research programs focused on deep-sea exploration and sustainability.<br>▪ Expand global funding network and establish recurring funding channels. | ▪ Expanded market reach and strengthened industry reputation.<br>▪ Increased innovation and technological advancements through research collaborations.<br>▪ Secured consistent funding from recurring partners and successful grants.<br>▪ Recognition as a leader in deep-sea exploration and marine sustainability. |
| **Long-Term (5+ Years)** | ▪ Establish long-term strategic partnerships with global organizations (e.g., UNESCO, Horizon Europe).<br>▪ Scale research and innovation programs with academic institutions.<br>▪ Leverage the circular economy model to reinvest funding into continuous technological development. | ▪ Continuous growth through sustained global partnerships and increased market presence.<br>▪ Breakthrough innovations in marine technology and deep-sea exploration. |

| | | |
|---|---|---|
| | ▪ Position Pisces VI as a global leader in marine exploration and sustainability. | ▪ Ongoing funding through a self-sustaining cycle of partnerships and reinvestment.<br>▪ Established leadership in global marine conservation and exploration. |

## Discussion and Next Steps

*(Author: Sara Rahouli and, Mustafizur Rahman)*

The question of how to elevate Pisces VI from a sustainable to a regenerative business model, one that supports steady growth, secures long-term funding, and contributes positively to environmental and social sustainability, has been addressed. The steps outlined in the recommendations provide a comprehensive framework; however, additional actions are necessary to fully achieve a regenerative economy.

**Have We Answered the Question?**

The recommendations discussed in the previous sections address the core question by focusing on the key elements of regenerative business: enhancing environmental sustainability, diversifying revenue models, fostering long-term partnerships, and increasing social value. The proposed steps, such as increasing circularity in operations, expanding funding channels, and improving brand visibility, clearly outline the actions Pisces VI can take toward a regenerative economy.

However, to elevate Pisces VI to a higher level of regeneration, the company must move beyond incremental improvements and pursue more integrated, systemic changes. The following steps, derived directly from the Recommendation section, outline how Pisces VI can enhance its regenerative impact.

**Extra Steps Needed**

*Environmental Regeneration*

- Marine Regeneration Programs:

As recommended in the Next Steps, Pisces VI should initiate or collaborate on large-scale marine ecosystem restoration projects, particularly those focusing on biodiversity offsets and ocean regeneration. These projects could target areas affected by climate change, such as coral reefs or seagrass ecosystems, where the company's deep-sea technology could aid in restoration efforts.

- Circular Innovation in Materials and Maintenance:

Pisces VI can strengthen its circular practices by not only refurbishing components but also actively engaging in remanufacturing and recycling of submarine parts. Collaborating with initiatives like EU Blue Economy Projects could offer valuable

insights into advanced recycling methods and sustainable materials, further reducing the company's environmental footprint while improving the efficiency of operations.

### *Economic Sustainability with Regenerative Models*

- Diversify Revenue Streams through Innovation:

Expanding the commercialization of Pisces VI's marine technology is a key action. As suggested, the company can develop and license technologies for ocean monitoring, which could be sold to research organizations, conservation groups, and governmental bodies. This would generate steady income while contributing to global marine health.

- Regenerative Finance Model:

Pisces VI should implement a regenerative finance model by reinvesting a portion of its revenue into ocean conservation. This could involve building long-term funding relationships with organizations like the Global Environment Facility (GEF) and the Blue Action Fund, ensuring financial sustainability and supporting regenerative projects.

### *Social Sustainability and Community Engagement*

- Educational Initiatives:

The company could enhance its social sustainability efforts by launching STEM education programs focused on marine conservation and deep-sea exploration. Collaborating with local universities in Tenerife, such as the University of La Laguna, could offer opportunities for internships, workshops, and research projects that directly involve students and the broader community in sustainability practices.

- Open Data and Collaborative Research:

Pisces VI could increase its societal value by creating an open-access platform for sharing exploration data. This aligns with the open science initiatives suggested in the recommendations, fostering collaboration between Pisces VI, research institutions, and environmental organizations to enhance global marine conservation efforts.

### *Building Stronger Partnerships*

- Long-Term Strategic Collaborations:

Collaborations with key academic, governmental, and private entities can help Pisces VI move beyond short-term contracts to secure long-term, stable partnerships. Establishing partnerships with renowned organizations like the Monterey Bay Aquarium and UNESCO IOC will increase Pisces VI's credibility, access to funding, and research opportunities, thus supporting the transition to a regenerative economy.

While Pisces VI is already on the path to sustainability, these additional steps—focused on marine regeneration, circular innovation, economic diversification, and social engagement—are crucial to elevating the company to a higher level of regenerative economy. By implementing these targeted actions, Pisces VI can lead the deep-sea exploration industry in creating a restorative, self-sustaining business model that contributes to both environmental and social regeneration.

# 4. FINAL DISCUSSION AND RECOMMENDATIONS

## 4.1. Joint Recommendations for Tenerife

*(Authors: Theogene Maniraguh, Mahek Suchdev, Jorge Novais, Harsh Lokhande, Parth)*

Tenerife's vision for sustainability hinges on adopting regenerative and circular principles to address its environmental challenges while driving economic resilience. The Circular Innovation Boot Camp engaged five teams in analyzing the sustainability issues and solutions for companies—IACTEC, TAGUA, Loro Parque, WOOPTIX, and PISCES VI. Together, these insights provide a roadmap for leveraging industry-specific innovations to create synergies and tackle island-wide issues such as tourism congestion, resource scarcity, and biodiversity loss These solutions are further enriched by the broader understanding of Tenerife's potential as both a natural and cultural destination. By enhancing sustainability measures, promoting responsible tourism, and adopting innovative solutions, the island can transition to a regenerative economy.

### Integrated Strategic Recommendations

**Traffic and Tourism Congestion Management**

- Critical Insights and Synergies

Tourism congestion in high-traffic areas such as Teide National Park and urban centers like Santa Cruz strains local ecosystems and reduces the quality of visitor experiences. Insights from Wooptix's optical tracking technologies offer scalable solutions for real-time monitoring and management of tourist flows. Complementarily, TAGUA's proposed electric fleet initiatives provide a foundation for sustainable mobility systems across the island, reducing dependency on private vehicles and mitigating emissions. Additionally, promoting eco-friendly transportation options like bike-sharing systems and pedestrian zones aligns with broader sustainability goals

- Proposed Strategic Actions

**Short-Term (1–3 Years):** Deploy IoT and AI systems to monitor and predict tourist movements, guiding visitors toward less congested attractions or recommending off-peak visitation hours. Introduce renewable-powered shuttle services connecting major tourism hubs, modeled after Madeira's electric shuttles.

**Medium-Term (5–10 Years):** Establish car-free zones in urban areas such as Santa Cruz and Puerto de la Cruz to enhance pedestrian accessibility and improve air quality. Launch bike-sharing systems and eco-friendly cable cars to connect urban and rural destinations.

**Long-Term (10+ Years):** Develop a fully integrated zero-carbon transportation network powered by renewables, including electric railways, buses, and sustainable mobility hubs. This aligns with Tenerife's 2040 decarbonization goals

Quantified Impact: These measures could reduce traffic-related carbon emissions by 30% within a decade while improving visitor experiences and redistributing economic benefits to lesser-known attractions.

## Industrial Symbiosis with Local Agriculture

**Critical Insights and Synergies**

Tenerife's banana plantations and other agricultural activities generate significant organic waste, presenting opportunities for circular resource utilization. TAGUA's expertise in resource recycling and wastewater reuse complements efforts to valorize agricultural byproducts into bio-based materials and renewable energy sources. Expanding agro-tourism initiatives also enables farmers to diversify income streams while promoting sustainable practices to visitors.

**Proposed Strategic Actions**

- **Short-Term (1–3 Years):** Pilot biogas facilities to convert banana waste into renewable energy and organic fertilizers. Integrate these efforts with agro-tourism programs, offering immersive experiences to educate visitors about sustainable farming practices.
- **Medium-Term (5–10 Years):** Expand bio-based packaging production using banana leaves, addressing the global demand for alternatives to single-use plastics. Establish centralized composting facilities to process agricultural waste into high-quality fertilizers.
- **Long-Term (10+ Years):** Develop a bioeconomy hub that integrates agricultural, industrial, and research efforts, positioning Tenerife as a global leader in bio-based industries. Such a hub could attract investments, foster innovation, and stimulate the local economy.

Quantified Impact: Valorizing agricultural waste could divert over 100,000 tons of organic material annually from landfills, reduce methane emissions by 40%, and generate €5 million in added economic value.

## Renewable Energy Transition

**Critical Insights and Synergies**

Tenerife's energy-intensive sectors, including desalination and tourism, place a significant strain on limited resources. TAGUA's renewable-powered desalination model and WOOPTIX's collaborative R&D initiatives provide a pathway for integrating solar and wind energy across the island's energy systems.

**Proposed Strategic Actions**

- **Short-Term (1–3 Years):** Transition existing desalination plants to hybrid systems powered by solar and wind energy. Incentivize hotels and resorts to install rooftop solar panels, expanding the renewable energy footprint in tourism infrastructure.

- **Medium-Term (5–10 Years):** Develop community solar projects and expand energy storage systems, addressing the intermittency of renewable energy sources while fostering inclusivity.
- **Long-Term (10+ Years):** Establish Tenerife as a global hub for renewable-powered desalination technologies, sharing expertise with other island economies facing similar challenges.

Quantified Impact: A 50% reduction in carbon emissions from desalination and tourism operations could be achieved within 15 years, along with significant energy independence and cost savings.

## Biodiversity and Ecosystem Restoration

**Critical Insights and Synergies**

Marine and terrestrial ecosystems in Tenerife face mounting threats from climate change and human activity. PISCES VI's submarine research and Loro Parque Fundación's conservation programs highlight the urgency of ecosystem restoration and biodiversity protection.

**Proposed Strategic Actions**

- **Short-Term (1–3 Years):** Develop artificial reefs in partnership with PISCES VI and establish no-fishing zones in critical habitats. Expand Loro Parque's reforestation initiatives focusing on native species.
- **Medium-Term (5–10 Years):** Implement large-scale mangrove restoration projects and launch citizen science initiatives involving residents and tourists in ecological monitoring.
- **Long-Term (10+ Years):** Foster genetic research on climate-resilient species, collaborating with international conservation organizations to safeguard biodiversity.

Quantified Impact: These initiatives could restore 1,000 hectares of degraded land and marine ecosystems annually, contributing to carbon sequestration equivalent to removing 20,000 cars from the roads.

## Conclusion

Tenerife, with its extraordinary natural and cultural heritage, exemplifies the potential to redefine sustainability through innovation and collaboration. By embracing these integrated strategies, Tenerife can transition to a regenerative economy, addressing pressing challenges such as resource scarcity, biodiversity loss, and tourism congestion. This approach not only ensures economic and environmental resilience but also positions the island as a global leader in sustainable practices, inspiring other regions worldwide.

1. Tenerife, with all its incredible experiences that we discovered in the week we spent there, can be only described as a beautiful place to visit. Nevertheless, everything can be perfected. One of the talking points that we wanted to share concerning our joint recommendations for Tenerife with the tourism agency is its sustainability and ecological value as an energy source and so, to be able to improve it further.
2. To this end, we propose the following joint recommendations:
3. Green life begins with the power of the idea of responsible tourism among the visitors and telling them that they should play this role during every day of their visit. This can occur through awareness of their responsibilities as travelers, thus, promoting the locals in their businesses and getting them to practice minimal waste.
4. Put Sustainable Transportation First: Focus the efforts and support the environmentally friendly transportation alternatives, consisting of electric cars, public transport services along with bicycles paths.
5. Save Water Resources: Execute the policies that will ensure the main facilities such as hotels (such as Taburiente), restaurants (such as Patio Canario), and the other tourist facilities will consume less water. Shaping tourists in such a way as to make them think about water responsibly and to give them the skills for saving water are other possibilities.
6. From one perspective, Tenerife can fulfill this objective by increasing efforts for coastal ecosystems conservation, which contain coral reefs and marine animals (right, Loro Parque?). The targets will be reached by cutting off the plastics, stopping the overfishing of the world's oceans, and making a campaign for developing sustainable fishing methods.
7. Invest in the green sources of energy: Although exploiting renewable sources of energy is not very easy, forcing a mega power station to be shut down would literally mean putting thousands of young generations on a diet of starvation by the end of the month.
8. By being highly dedicated to the impact that any tourist activity has on the environment, Tenerife can exploit its unique selling proposition of green tourism. Through this, it will not only be a part of such a revolution but also expand its own industry and the world.

## 4.2. Key Insights Across Case Studies

*(Authors: Theo, Mahek, Jorge Novais, Harsh, Parth)*

**Interconnection of Sustainability and Circular Economy:**

All case studies reveal a shift from linear models to circular and regenerative frameworks. Companies like Loro Parque integrate recycling and renewable energy initiatives, while TAGUA focuses on water reuse and desalination. These efforts highlight the growing importance of circular economy practices in achieving sustainability.

**Role of Innovation:**

Innovative approaches such as gamification (Loro Parque), brine mining (TAGUA), and cutting-edge astrophysics solutions (IACTEC) underline the critical role of technology in addressing environmental challenges.

**Local Resources and Community Involvement:**

Leveraging Tenerife's local resources—banana leaves (Loro Parque) or desalinated water (TAGUA)—emphasizes sustainable use while creating economic opportunities for local communities.

**Common Barriers:**

Key challenges include high energy demands, regulatory hurdles, and the need for public acceptance of new methods, such as wastewater reuse or alternative materials.

### Overarching Themes and Patterns

**Alignment with Regenerative Economy:**

Each organization demonstrates progression toward the RESTORE model's advanced stages (restorative or regenerative), reflecting a collective move beyond sustainability into active ecosystem restoration.

**Public Engagement as a Catalyst:**

Interactive and educational programs (e.g., Loro Parque’s exhibits, TAGUA’s outreach) serve as key tools to shift societal behaviors and promote sustainable actions.

**Collaborative Innovation:**

Partnerships with academic institutions, NGOs, and governments emerge as a common strategy for scaling impact, as seen in TAGUA’s collaboration with the University of La Laguna and Loro Parque Fundación’s global projects**.**

**Economic Opportunities for Sustainability:**

Economic incentives, such as monetizing waste (banana leaves, brine), highlight the financial viability of sustainable practices, providing a dual benefit of environmental protection and revenue generation.

## Collaborative Opportunities

### 1. Resource Sharing Across Sectors

- **Waste Utilization**:
  Loro Parque generates significant amounts of organic waste from its facilities, which could be repurposed into compost or biofuel with TAGUA's water and waste management expertise. For example:
  - Organic waste could be transformed into compost for TAGUA's water treatment plants, which use vegetation buffers.
  - Treated wastewater from TAGUA could irrigate Loro Parque's botanical gardens, ensuring a circular water use cycle.
- **Energy Integration**:
  IACTEC's advancements in solar and renewable energy systems could provide clean energy solutions to power Loro Parque's operations or TAGUA's desalination plants. Shared infrastructure for renewable energy deployment (e.g., solar farms or wind turbines) could reduce costs and carbon footprints.

### 2. Co-Creation of Public Engagement Platforms

- **Sustainability Awareness Initiatives**:
  A joint platform could be developed to educate visitors and locals about Tenerife's progress toward a circular economy. For example:
  - Loro Parque's interactive exhibits could feature TAGUA's desalination processes or IACTEC's renewable energy projects.
  - Create a gamification ecosystem where visitors earn "eco-points" by participating in sustainable actions across all entities (e.g., using less water at TAGUA, attending Loro Parque's eco-lectures, or exploring IACTEC's innovations).
- **Unified Branding**:
  Promote Tenerife as a **Sustainability Innovation Hub** through joint campaigns highlighting the achievements and interconnections of all case study entities. This could enhance tourism while raising awareness about sustainable practices.

### 3. Joint Research and Development Initiatives

- **Circular Economy Models**:
  Collaboratively explore models that demonstrate interconnectedness, such as:

- Researching alternative uses for banana leaves with input from TAGUA's waste processing expertise.
- Developing closed-loop systems where byproducts from desalination (e.g., brine) are used in aquaculture systems supported by Loro Parque Fundación.

- **Technology Development**:
  Leverage IACTEC's expertise in precision engineering and AI to create smart monitoring systems for water usage and energy efficiency in both Loro Parque and TAGUA operations.

**4. Policy Advocacy and Sustainable Standards**

- **Collaborative Advocacy for Regulatory Change**:
  Develop a unified voice to advocate for policies supporting renewable energy, sustainable tourism, and circular economy practices in Tenerife. For example:
  - Advocate for financial incentives for businesses using renewable energy or converting waste into resources.
  - Create a shared policy proposal framework highlighting the contributions of all entities to Tenerife's sustainability goals.

- **Standardization of Circular Practices**:
  Work together to create a Tenerife-specific sustainability standard that can serve as a benchmark for other islands, showcasing success stories such as TAGUA's water reuse and Loro Parque's renewable energy adoption.

**5. Leveraging Academic and Institutional Partnerships**

- **Collaborative Research Projects**:
  Partner with the University of La Laguna and other local institutions to study:
  - The feasibility of brine reuse in agriculture or aquaculture.
  - The economic impact of circular practices in tourism and water management.

- **Talent Development**:
  Launch a joint internship or fellowship program where students gain hands-on experience in renewable energy (IACTEC), water management (TAGUA), and conservation (Loro Parque), fostering a new generation of sustainability-focused professionals.

**6. Tourism and Community Development**

- **Integrated Eco-Tourism Packages**:
  Offer tourism packages that provide visitors with a comprehensive sustainability experience:

    - Start with a visit to TAGUA's desalination facility to learn about water sustainability.
    - Move to Loro Parque to explore conservation and circular economy practices.
    - End with a tour of IACTEC's renewable energy projects, showcasing Tenerife's vision for a regenerative economy.

- **Community-Centric Initiatives**:
  Collaborate on programs that directly benefit local residents:
    - TAGUA providing subsidized water for community agriculture projects.
    - Loro Parque offering workshops on biodiversity conservation and sustainable practices.
    - IACTEC hosting events to teach locals about renewable energy adoption.

**7. Island-Wide Ecosystem for Data and Resource Management**

- **Shared Data Infrastructure**:
  Develop a unified data system where all entities share real-time insights into water usage, energy consumption, and waste generation, optimizing resource allocation across sectors.
- **Digital Sustainability Hub**:
  Create a centralized app or web portal where visitors, residents, and businesses can track their contributions to Tenerife's circular economy. Features could include:
    - Visitor engagement metrics from Loro Parque's gamification system.
    - Water savings data from TAGUA.
    - Renewable energy contributions from IACTEC.

**8. Pilot Projects for Innovation**

- **Aquaculture Systems Using Desalination Byproducts**:
  TAGUA and Loro Parque could partner on aquaculture projects where desalination brine supports salt-tolerant plant or fish species, demonstrating resource reuse.

**Renewable-Powered Tourism Facilities**:
Use IACTEC's renewable energy advancements to power eco-friendly lodges or facilities near Loro Parque, creating an immersive sustainability experience.

# 5. REFERENCES

**Book Sources:**


Andreucci, M. B./Marvuglia, A./Baltov, M./Hansen, P. (2021): Rethinking Sustainability Towards a Regenerative Economy, Barcelona, 2021.

Akinci, S., & Kucuk, S. (2021) 'The impact of web marketing on corporate social responsibility (CSR) and firms' performance', Research Agenda in Management, 15(3), pp. 22-34. doi: 10.1108/ramj-03-2021-0022.

Fullerton, J. (2015): Regenerative Capitalism: How Universal Principles And Patterns Will Shape Our New Economy, n. L., 2015.

Gude, V.G. (2017) 'Desalination and water reuse to address global water scarcity', Reviews in Environmental Science and Biotechnology. Springer Netherlands, pp. 591–609. Available at: https://doi.org/10.1007/s11157-017-9449-7.

Howard, M. / Hopkinson, P. / Miemczyk, J. (2018): The regenerative supply chain: a framework for developing circular economy indicators. International Journal of Production Research, Vol. 57(23), 7300–7318.

Ihsanullah, I. et al. (2021) 'Desalination and environment: A critical analysis of impacts, mitigation strategies, and greener desalination technologies', Science of the Total Environment. Elsevier B.V. Available at: https://doi.org/10.1016/j.scitotenv.2021.146585.

Kim, Y.C. and Elimelech, M. (2013a) 'Potential of osmotic power generation by pressure retarded osmosis using seawater as feed solution: Analysis and experiments', Journal of Membrane Science, 429, pp. 330–337. Available at: https://doi.org/10.1016/j.memsci.2012.11.039.

Kim, Y.C. and Elimelech, M. (2013b) 'Potential of osmotic power generation by pressure retarded osmosis using seawater as feed solution: Analysis and experiments', Journal of Membrane Science, 429, pp. 330–337. Available at: https://doi.org/10.1016/j.memsci.2012.11.039.

Morseletto, P. (2020): Restorative and regenerative: Exploring the concepts in the circular economy. Journal Of Industrial Ecology, Vol. 24(4), 763–773.

Omerspahic, M. et al. (2022a) 'Characteristics of Desalination Brine and Its Impacts on Marine Chemistry and Health, With Emphasis on the Persian/Arabian Gulf: A Review', Frontiers in Marine Science. Frontiers Media S.A. Available at: https://doi.org/10.3389/fmars.2022.845113.

Omerspahic, M. et al. (2022b) 'Characteristics of Desalination Brine and Its Impacts on Marine Chemistry and Health, With Emphasis on the Persian/Arabian Gulf: A Review', Frontiers in Marine Science. Frontiers Media S.A. Available at: https://doi.org/10.3389/fmars.2022.845113.

Oron, G., Appelbaum, S. and Guy, O. (2023) 'Reuse of brine from inland desalination plants with duckweed, fish and halophytes toward increased food production and improved environmental control', Desalination, 549. Available at: https://doi.org/10.1016/j.desal.2022.116317.

Pramanik, B.K., Shu, L. and Jegatheesan, V. (2017) 'A review of the management and treatment of brine solutions', Environmental Science: Water Research and Technology. Royal Society of Chemistry, pp. 625–658. Available at: https://doi.org/10.1039/c6ew00339g.

Rimanoczy, I. (2019). Sustainability Mindset. In: Encyclopedia of Sustainability in Higher Education, Springer.

Sánchez, A.S., Nogueira, I.B.R. and Kalid, R.A. (2015) 'Uses of the reject brine from inland desalination for fish farming, Spirulina cultivation, and irrigation of forage shrub and crops', Desalination, 364, pp. 96–107. Available at: https://doi.org/10.1016/j.desal.2015.01.034.

Savitz, Andrew & Weber, Karl. (2006). The Triple Bottom Line How Today's Best-Run Companies Are Achieving Economic, Social, and Environmental Success— and How You Can Too.

Shaffer, B. (2019): Global energy trends: Demands for scientific innovation. MRS Energy & Sustainability, Vol. 6 (2).

Skrucany, Tomas & Kendra, Martin & Kalina, Tomáš & Jurkovič, Martin & Vojtek, Martin & Synák, František. (2018). Environmental Comparison of Different Transport

Tomassini, L. & Cavagnaro, E. (2022): Circular economy, circular regenerative processes, a growth and placemaking for tourism future. Journal Of Tourism Futures, Vol. 8(3), 342–345.

Tularam, G.A. and Ilahee, M. (2007) 'Environmental concerns of desalinating seawater using reverse osmosis', Journal of Environmental Monitoring, pp. 805–813. Available at: https://doi.org/10.1039/b708455m.

von Goethe, J. W. (1869): Aphorisms on Nature, n. L., 1869.

Geissdoerfer, Martin & Savaget, Paulo & Bocken, Nancy & Hultink, Erik. (2017). The Circular Economy – A new sustainability paradigm?. Journal of Cleaner Production. 143. 757–768. 10.1016/j.jclepro.2016.12.048.

Elkington, J. (1997). The triple bottom line. Environmental management: Readings and cases, 2, 49-66.

Kleindorfer, Paul R. & Singhal, Kalyan & Van Wassenhove, Luk N. (2005). Sustainable Operations Management. Production and Operations Management, Vol 14

Nusa, Kevın & Kodak, Gizem. (2023). Comparison of Maritime and Road Transportations in Emissions Perspective: A Review Article. International Journal of Environment and Geoinformatics. 10. 48-60. 10.30897/ijegeo.1254161.

Campbell, James F. (1990). Freight consolidation and routing with transportation economies of scale - Transportation Research Part B: Methodological. Vol. 24(5), P. 345 – 361

Williams, J. (no date a) Desalination in the 21st Century: A Critical Review of Trends and Debates. Available at: www.water-alternatives.org.

Williams, J. (no date b) Desalination in the 21st Century: A Critical Review of Trends and Debates. Available at: www.water-alternatives.org.

Zayat, H. El, Nasr, P. and Sewilam, H. (no date a) 'Investigating sustainable management of desalination brine through concentration using forward osmosis'. Available at: https://doi.org/10.1007/s11356-021-13311-z/Published.

**Internet Sources:**

Instituto de Astrofísica de Canarias (n. d.): About Us, retrieved from https://www.iac.es/en/about-us [23/11/2024].

Recapp (2024): What are The Three Principles of Circular Economy, retrieved from https://www.gorecapp.com/blog/post/what-are-the-three-principles-of-a-circular-economy [26/11/2024].

International Association of Amusement Parks and Attractions (IAAPA) (2024) 'It's All Fun and Games: Exploring Gamification in Parks and Attractions'. Available at: https://www.iaapa.org/expos/iaapa-expo-2024/sessions/its-all-fun-and-games-exploring-gamification-parks-and-attractions (Accessed: 29 November 2024).

N-Gage (2023) 'Conservation and the Power of Technology to Improve Audience Engagement'. Available at: https://www.n-gage.io/insights/blog/conservation-and-the-power-of-technology-to-improve-audience-engagement (Accessed: 29 November 2024).

**Loro Parque Fundación** (2022) 'Loro Parque Fundación to Dedicate 1.45 Million to Biodiversity Conservation in 2022'. Available at: https://www.loroparque-fundacion.org/en/loro-parque-fundacion-to-dedicate-1-45-million-to-biodiversity-conservation-in-2022/ (Accessed: 29 November 2024).

Environmental Protection Agency (EPA) (2024) 'Sustainability'. Available at: https://www.epa.gov/sustainability (Accessed: 29 November 2024).

Ellen MacArthur Foundation (n.d.) 'Circular Economy Principles'. Available at: https://www.ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview (Accessed: 29 November 2024).

Papyrus Australia (n.d.) 'Technology'. Available at: https://papyrusaustralia.com.au/technology/ (Accessed: 29 November 2024).

Tenerife South Guide (n.d.) 'Banana Plantations'. Available at: https://tenerifesouthguide.com/banana-plantations/ (Accessed: 29 November 2024).

Wooptix. (n.d.) *About us*. Available at: https://wooptix.com/about-us/(Accessed: 27 November 2024).

Pitchbook. (n.d.) Company profiles: 163412-11. Available at: https://pitchbook.com/profiles/company/163412-11?utm_source=chatgpt.com#overview/ (Accessed: 27 November 2024).

EU-Startups. (2023) *Tenerife-based Wooptix closes €10 million Series B to automate its semiconductor metrology business*. Available at: https://www.eu-startups.com/2023/07/tenerife-based-wooptix-closes-e10-million-series-b-to-automate-its-semiconductor-metrology-business/ (Accessed: 27 November 2024).

Wooptix. (n.d.) *Wavefront sensor*. Available at: https://wooptix.com/wavefront-sensor/ (Accessed: 27 November 2024).

Wooptix. (n.d.) *Semiconductor manufacturing*. Available at: https://wooptix.com/semiconductor-manufacturing/ (Accessed: 27 November 2024).

Wooptix. (n.d.) *SEBI RT1000 helps the planet*. Available at: https://wooptix.com/sebi-rt1000-helps-the-planet/ (Accessed: 27 November 2024).

Wooptix. (n.d.) *Enhancing the quality control of solar panels with a phase camera*. Available at: https://wooptix.com/enhancing-the-quality-control-of-solar-panels-with-a-phase-camera/ (Accessed: 27 November 2024).

Weather and Climate (n.d.). *Average monthly hours of sunshine in Tenerife, Spain.* Available at: https://weather-and-climate.com/average-monthly-hours-Sunshine,Tenerife,Spain [Accessed 28 November 2024].

Noronha, Patricia Maia. (2024) Winds of change: reshaping Tenerife's energy economy. Retrieved from: https://www.nature.com/articles/d41586-024-02606-z#:~:text=Tenerife%2C%20the%20largest%20of%20Spain's,the%20Sun%20and%20the%20wind.

Electricity Maps (2024), Teneriffa. Retrieved from: https://app.electricitymaps.com/zone/ES-CN-TE/all

Electricity Maps (2024), Spain. Retrieved from: https://app.electricitymaps.com/zone/ES/all

Byrne, Tim (2011) Waste collection in Spain - Tourists, trash and trucks on Tenerife. Retrieved from: https://www.ategrus.org/images/stories/residuos/recogida_transporte/RWW_757_Tenerife.pdf

Medina, Juan Antonio (2021) Arico tiene los próximos 200 años hipotecados con el vertedero insular. Retrieved from: https://www.eldia.es/tenerife/2021/10/07/arico-proximos-200-anos-hipotecados-58099518.html

Servicio Técnico de Desarrollo Sostenible. The Special Territorial Plan for Waste Regulation. Retrieved from: https://www.tenerife.es/portalcabtfe/en/site_content/53-residuos/807-plan-territorial-especial-de-ordenacion-de-residuos?pop=1&print=1&tmpl=component

Valdemingómez Technology Park (2023) Annual report Executive Summary. Retrieved from: https://www.madrid.es/UnidadWeb/NxC/Valdemingomez2020/Publicaciones_Videos/ficheros/SummaryReportValdemingomez2023.pdf

V. Pawlik, 2024: Pro-Kopf-Stromverbrauch in Spanien in den Jahren 2013 bis 2023 | Published: 10/18/2024 from:

https://de.statista.com/statistik/daten/studie/565805/umfrage/pro-kopf-stromverbrauch-in-spanien/#:~:text=Die%20Statistik%20zeigt%20die%20Entwicklung,5%2C1%20Megawattstunden%20Strom%20verbraucht.

Ellen MacArthur Foundation (2021). What is the circular economy? [Online] Verfügbar unter: https://ellenmacarthurfoundation.org [Accessed 28 November 2024].

United Nations (2020). Sustainable Development Goals: Goal 12 – Responsible Consumption and Production. [Online] Verfügbar unter: https://sdgs.un.org/goals/goal12 [Accessed 28 November 2024].

University of Virginia (2024). Partnerships. Verfügbar unter: https://sustainability.virginia.edu [Accessed 28 November 2024].

Global Reporting Initiative (2021). GRI Standards: Sustainability Reporting Framework. [Online] Verfügbar unter: https://www.globalreporting.org

EOD, 2024: Global Footprint Network – Earth Overshoot Day 2024 | Published: 2024 from: https://overshoot.footprintnetwork.org/newsroom/country-overshoot-days/

European Parliament, 2023: Circular economy: definition, importance and benefits | Published: 24-05-2023 from:

https://www.europarl.europa.eu/topics/de/article/20151201STO05603/kreislaufwirtschaft-definition-und-vorteile#:~:text=Was%20ist%20eine%20Kreislaufwirtschaft%3F,der%20Lebenszyklus%20der%20Produkte%20verl%C3%A4ngert

Lucía Fernández, 2024: Share of renewable electricity in Spain 2008-2023 | Published: May 24, 2024 from:

https://www.statista.com/statistics/419432/spain-share-of-electricity-from-renewable-sources/#:~:text=From%202008%20to%202023%2C%20the,than%20half%20of%20electricity%20generation

European Parliamentary Research Service. (2024, 02 11). europa.eu. Retrieved from https://what-europe-does-for-me.europarl.europa.eu/en/region/ES709

Klawters. (2023, 03 16). canaryislandshub.com. Retrieved from https://canaryislandshub.com/category-news/canary-islands-special-zone-zec-the-best-taxation-in-europe/

Numbeo. (2024). numbeo.com. Retrieved from https://www.numbeo.com/cost-of-living/compare_cities.jsp?country1=Spain&city1=Madrid&country2=Spain&city2=Santa+Cruz+de+Tenerife

Salary Expert. (2024). salaryexpert.com. Retrieved from https://www.salaryexpert.com/salary/area/spain/santa-cruz-de-tenerife

Statista. (2024, 07 05). statista.com. Retrieved from https://www.statista.com/statistics/456195/unemployment-rate-in-madrid/#:~:text=Unemployment%20rate%20in%20Madrid%20from%20Q1%202013%20to%20Q4%202023&text=Madrid%20hit%20a%20historic%20record,the%20fourth%20quarter%20of%202023

European Commission, n.d. Horizon Europe: Funding and Tenders. Available at: https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en

Monterey Bay Aquarium, n.d. Ocean Conservation Advocacy. Available at: https://www.montereybayaquarium.org/conservation-and-science

OpenGrants, n.d. Grant Application Platform. Available at: https://opengrants.io

UNESCO Intergovernmental Oceanographic Commission, n.d. IOC: Marine Science and Research. Available at: https://ioc.unesco.org

The Ocean Foundation, n.d. Funding for Marine Sustainability Projects. Available at: https://oceanfdn.org

European Parliament, 2021. EU Blue Economy: Sustainable Marine Resource Initiatives. Available at: https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2021)690527

NOAA, n.d. Projects of Special Merit: Funding Opportunities. Available at: https://www.grants.gov

Sea Technology, 2024. Sea Grant Aquaculture Research (2024–2025). Available at: https://sea-technology.com/sea-grant-funding-fy-2024-2025-us-aquaculture

# 6. APPENDICES

## Appendix A

*(Author: Sara Rahouli)*

**SDG 14 and 14.8 Organizations, Initiatives, and Funding Bodies**

| Entity Name | Website | Focus Area | Type | Region | Description/Notes | Contact Information |
|---|---|---|---|---|---|---|
| UNEP (United Nations Environment Programme) | https://www.unep.org/resources/report/sdg-14-life-below-water | Ocean conservation, marine pollution, sustainable use | UN body | Global | UNEP supports global efforts to conserve oceans and develop sustainable marine policies, focusing on reducing ocean pollution and enhancing marine protected areas. UNEP's efforts include ocean conservation programs, scientific research, and policy development. | Email: unep.info@unep.org |
| UNESCO - Intergovernmental Oceanographic Commission (IOC) | https://ioc.unesco.org/en | Ocean science, sustainable marine development | UN body | Global | IOC promotes ocean science, facilitates the sustainable use of oceans, and provides technical expertise on marine science, observing the oceans, and coastal management. IOC runs key programs like the Global Ocean Observing System (GOOS). | Email: ioc@unesco.org |

| | | | | | | |
|---|---|---|---|---|---|---|
| WWF (World Wildlife Fund) | https://www.wwf.org.uk/what-we-do/oceans | Marine conservation, sustainable fisheries | NGO | Global | WWF leads efforts to preserve marine biodiversity, focusing on sustainable fishing and reducing plastic pollution. WWF works to create sustainable ocean management practices and advocates for marine protection. | Email: info@wwf.org.uk |
| The Nature Conservancy (TNC) | https://www.nature.org/en-us/what-we-do/our-insights/perspectives/oceans/ | Marine conservation, sustainable fisheries, coastal protection | NGO | Global | TNC implements projects focused on restoring coral reefs, promoting sustainable fisheries, and combating ocean pollution. TNC works with governments and communities to conserve key marine ecosystems. | Email: tnc@tnc.org |
| Ocean Conservancy | https://oceanconservancy.org/ | Marine pollution, ocean cleanup, sustainability | NGO | Global | Ocean Conservancy advocates for ocean protection, focusing on reducing plastic waste and enhancing marine wildlife conservation. Their efforts include the International Coastal Cleanup initiative. | Email: info@oceanconservancy.org |
| NOAA (National Oceanic and Atmospheric Administration) | https://www.fisheries.noaa.gov/ | Ocean science, sustainable fisheries, marine ecosystems | US government agency | Global | NOAA leads research on marine ecosystems, provides fisheries management tools, and supports sustainable fisheries practices. NOAA also monitors the health of | Email: nmfs.publicaffairs@noaa.gov |

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|---|---|---|---|---|---|---|
| | | | | | oceans and promotes ocean conservation. | |
| Horizon Europe (EU Commission) | https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/home | Ocean-related research, innovation in marine technologies | EU program | Europe (EU) | Horizon Europe funds research projects, including those focused on ocean innovation, sustainable fisheries, and marine protection. It promotes research excellence in ocean sciences and related fields. | Email: RTD-HORIZON@ec.europa.eu |
| International Union for Conservation of Nature (IUCN) | https://www.iucn.org/theme/marine-and-polar | Marine biodiversity, sustainable fishing, ocean policy | NGO | Global | IUCN supports marine biodiversity conservation, focusing on policy, sustainable fisheries, and the protection of critical marine habitats. IUCN leads the Global Ocean Biodiversity Initiative. | Email: iucn@iucn.org |
| GESAMP (Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection) | http://www.gesamp.org/ | Marine environmental protection, pollution science | Scientific advisory body | Global | GESAMP advises UN and international bodies on marine pollution and environmental degradation, contributing to scientific knowledge on oceans and sustainable marine management. | Email: gesamp@un.org |
| Marine Stewardship Council (MSC) | https://www.msc.org/ | Sustainable fisheries certification | NGO | Global | MSC provides certification for sustainable fisheries, promoting ocean conservation through sustainable seafood practices. | Email: info@msc.org |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | Their certification helps drive consumer demand for sustainable fish. | |
| Global Environment Facility (GEF) | https://www.thegef.org/topics/oceans | Ocean pollution, marine biodiversity conservation | Funding body | Global | GEF funds projects to protect marine ecosystems, with a focus on ocean pollution and marine resource conservation. GEF supports international partnerships to address ocean health challenges. | Email: gef@thegef.org |
| Scripps Institution of Oceanography | https://scripps.ucsd.edu/ | Ocean science, climate change, marine ecosystems | Research institution | Global | Scripps conducts pioneering research in oceanography, focusing on the impacts of climate change on marine life and ecosystems. Their work also includes ocean health assessments. | Email: scrippsnews@ucsd.edu |