FIBREGY

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WP1 MARKET ATTRACTIVENESS, COST-BENEFIT ANALYSIS AND BUSINESS PLANS

DISSEMINATION VERSION

Task 1.1: Overview

Task 1.1. Floating wind market analysis and prospective monitoring

Participants: ENEROCEAN (L), BV, COMPASSIS, IXBLUE, TSI

Initial study of the potential applications of the use of composite solutions for offshore wind with a focus in a worldwide development of floating wind.

- Subtask 1.1.1. Market prospective for offshore wind use of composite solutions
- Subtask 1.1.2. Economic models for technical decision support in applications of composite structures and partial solutions.

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T 1.1.1: Market prospective for the application of composite solutions in offshore wind

- Most of the FRP materials in an offshore wind turbine are found in the blades, the nacelle cover and, to a lower extent, in the spinner or rotor cone. The rest of the offshore installation, i.e. tower, mooring and foundation/floating platform, is mainly made of steel. Fibregy project aims at extending the use of FRP as structural material for the towers and floating platform, or part of them.

- The preliminary business model of Fibregy identified six potential customer segments across the value chain: 1) wind farm developers; 2) FOW tech developers; 3) engineering and certification firms; 4) other tech developers (turbine and components); 5) shipyards; and 6) O&M contractors.

- Through the re-engineering and manufacturing of an FRP tower and an FRP joint for the substructure, Fibregy addresses two potential customer niches: 1) tower manufacturers and 2) shipyards. Both can be grouped under the structural components and systems manufacturing category.

- According to the World Steel Association, about 85% of wind turbines around the world are manufactured primarily from steel. Existing turbine models use between 107 and 132 t/MW of installed capacity.

- In the future, material efficiency will most likely improve, with a consequent reduction in material demand per turbine. On the other hand, a portion of the demand is likely to be redirected towards alternative and lighter materials in an effort to reduce costs while maintaining strength and satisfying structural fatigue requirements.

- Offshore wind project developers usually sign manufacture and construction agreements two years before starting the project. As pointed out in the *"Innovator's guide to the offshore wind market"* published by ORE Catapult, wind turbine supply agreements are signed first, while balance of plant equipment and installation services may be signed later. New innovative products and services need to consider these relationships when approaching potential customers.

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T 1.1.1: Market prospective for the application of composite solutions in offshore wind

- After analysing the needs of potential customers ("pain-points") and the competitive environment (existing solutions), a list of the top 12 qualitative factors was elaborated to assess the relative advantages of FRP solutions against competitors or substitutive products.

    1. Material manufacturing plant proximity to customer
    2. Material supply capacity to supply large batches in a short time
    3. Material availability
    4. Material weight reduction
    5. Material durability and fatigue requirements
    6. Material corrosion resistance
    7. Material ocean fouling release properties
    8. Material vibration reduction
    9. Material cost
    10. Material application in existing designs (ease of integration)
    11. Material manufacturability
    12. Material overall ecologic footprint (manufacturing energy use)

- The qualitative analysis revealed that in 7 out of 12 factors, FRP solutions were clearly superior to the steel or concrete equivalent.
- The advantage of steel and concrete are related to availability of manufacturing plants, supply capacity, cost, and application, which are not intrinsic to the materials, but linked to the maturity and experience using steel and concrete in the industry.
- Therefore, it is expected that FRP outperforms steel and concrete in all the relevant decision factors as its penetration in the market grows.

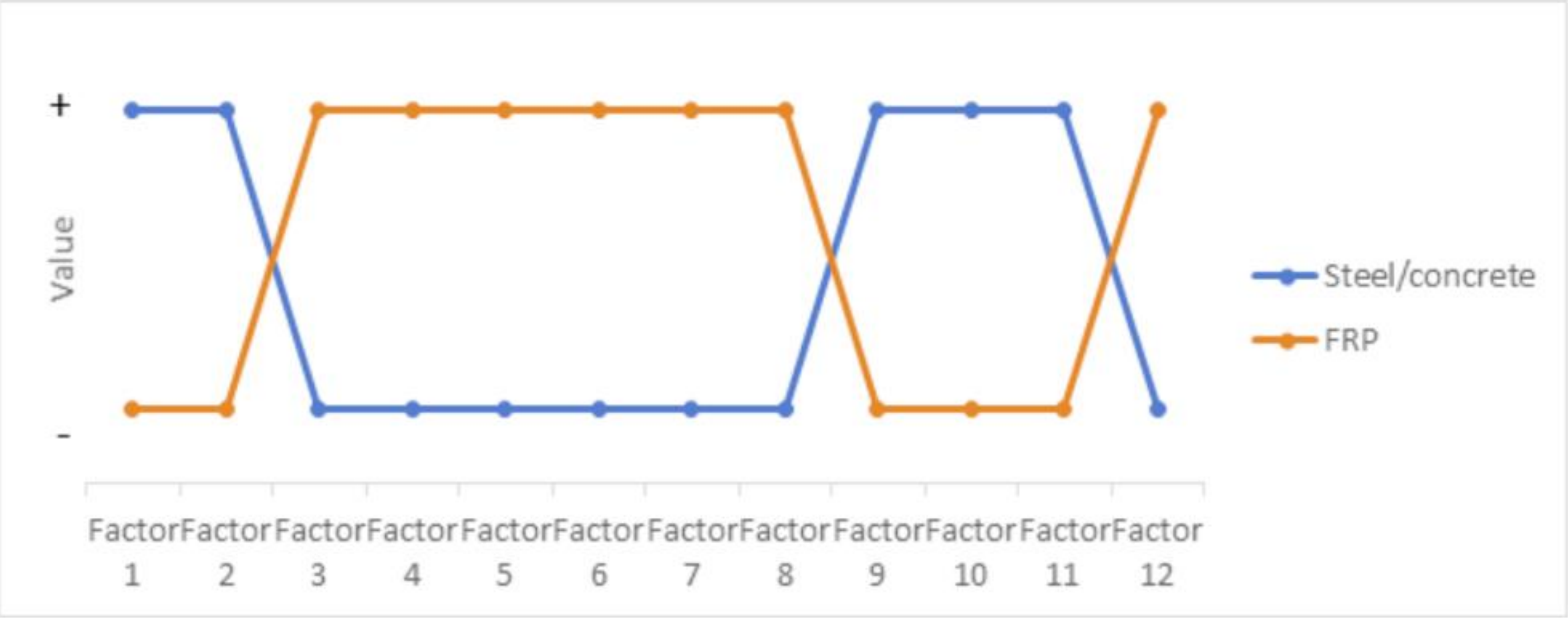

Figure 30. Value curve for a floating offshore wind platform built in FRP and in steel or concrete

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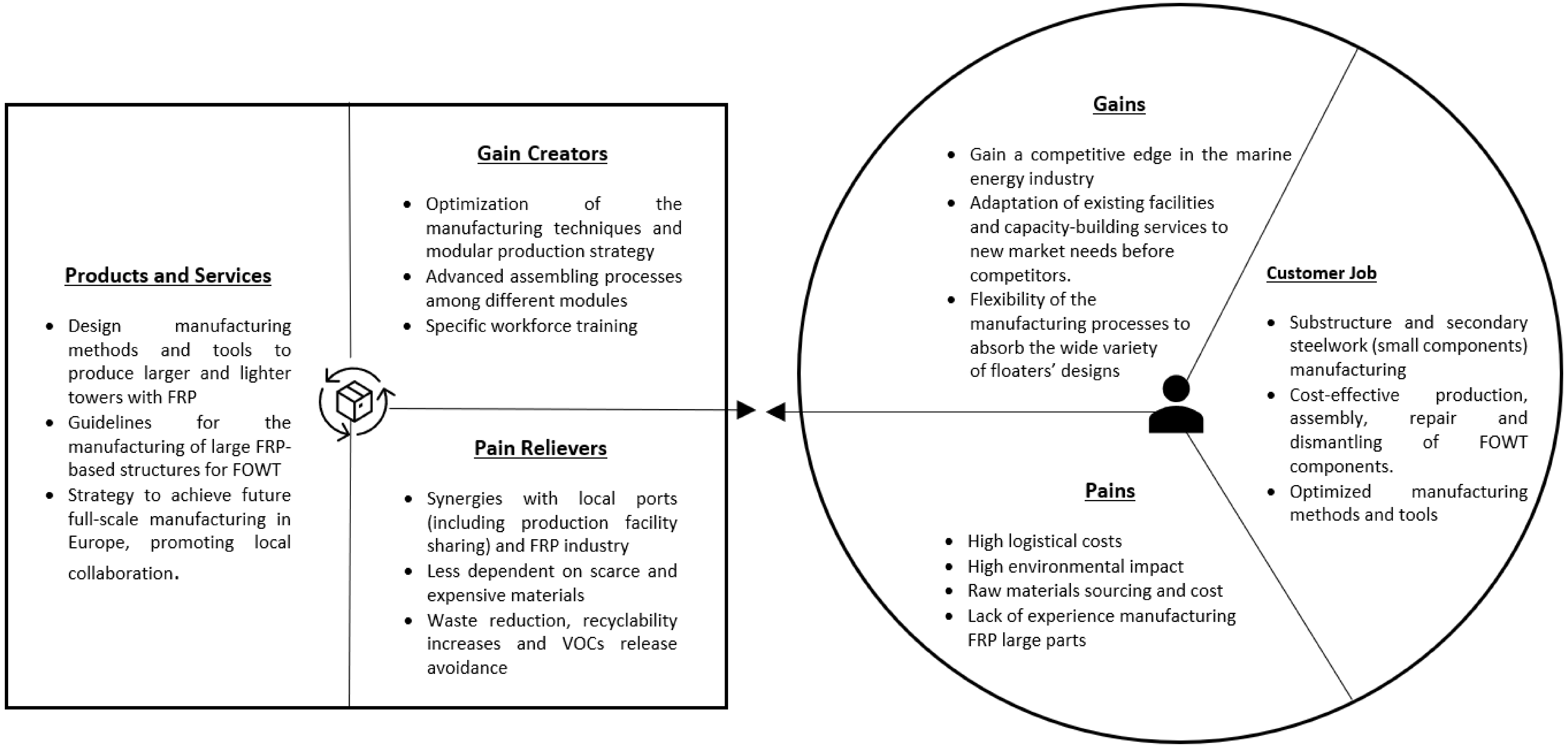
T 1.1.1: Market prospective for the application of composite solutions in offshore wind

- Based on the needs of the objective market niches identified in the strategic analysis, and on the qualitative benefits of FRP technology, a Value Proposition Canvas was elaborated for each potential customer niche.
- The Value Proposition canvas is a graphic representation of the market needs (circle) and how the solution satisfies them (square). The one on the right corresponds to the value proposition for shipyards working in the offshore wind industry.



T 1.1.1: Market prospective for the application of composite solutions in offshore wind

- The use of lightweight materials in the wind energy sector is expected to grow in the coming decades. Traditional steel will be substituted to a large extent by high-strength steel, but also by aluminium and fibre reinforced plastics including carbon or glass fibre.
- With respect to thermoplastics, currently not widely used as engineering materials in the sectors analysed here, the thermoplastic composites market size is projected to grow from USD 22.2 billion in 2020 to USD 31.8 billion by 2025, at a CAGR of 7.5%. The thermoplastic composites industry is growing due to its properties such as recyclability, fast processing, ability to mould and remould, survival at higher temperatures.
- Markets and Markets report about thermoplastic composites indicates that the use of composites in many potential applications are not commercially feasible yet because of the high cost.
- The production of low-cost thermoplastic composites would increase its consumption in different end-use applications. Therefore, development of low-cost technologies is the most pressing need for all research organizations and thermoplastic manufacturers.
- The results of FIBREGY are expected to lay the foundations for increasing use of composites in structural components for the offshore wind sector and possibly for the wind sector in general.
- This project aims to overcome the potential resistance to applying FRP materials for structural components in this industry by reducing the risk perception of investors in different ways such as: the development of a digital twin-based SHM and other advanced computational assessment models, the extensive testing validation and demonstration plan or providing new guidelines to accelerate certification, amongst others.

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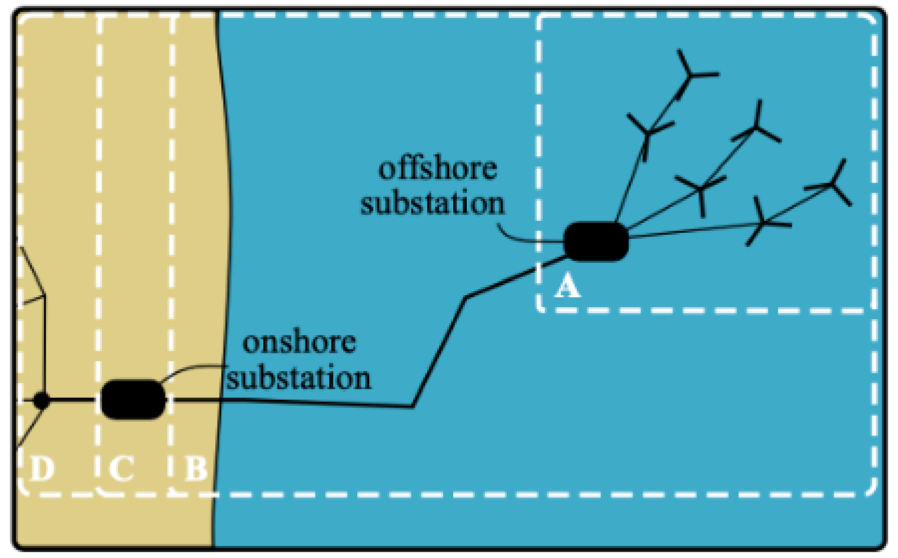
T 1.1.2: Economic models in applications of composite structures and partial solutions in offshore wind

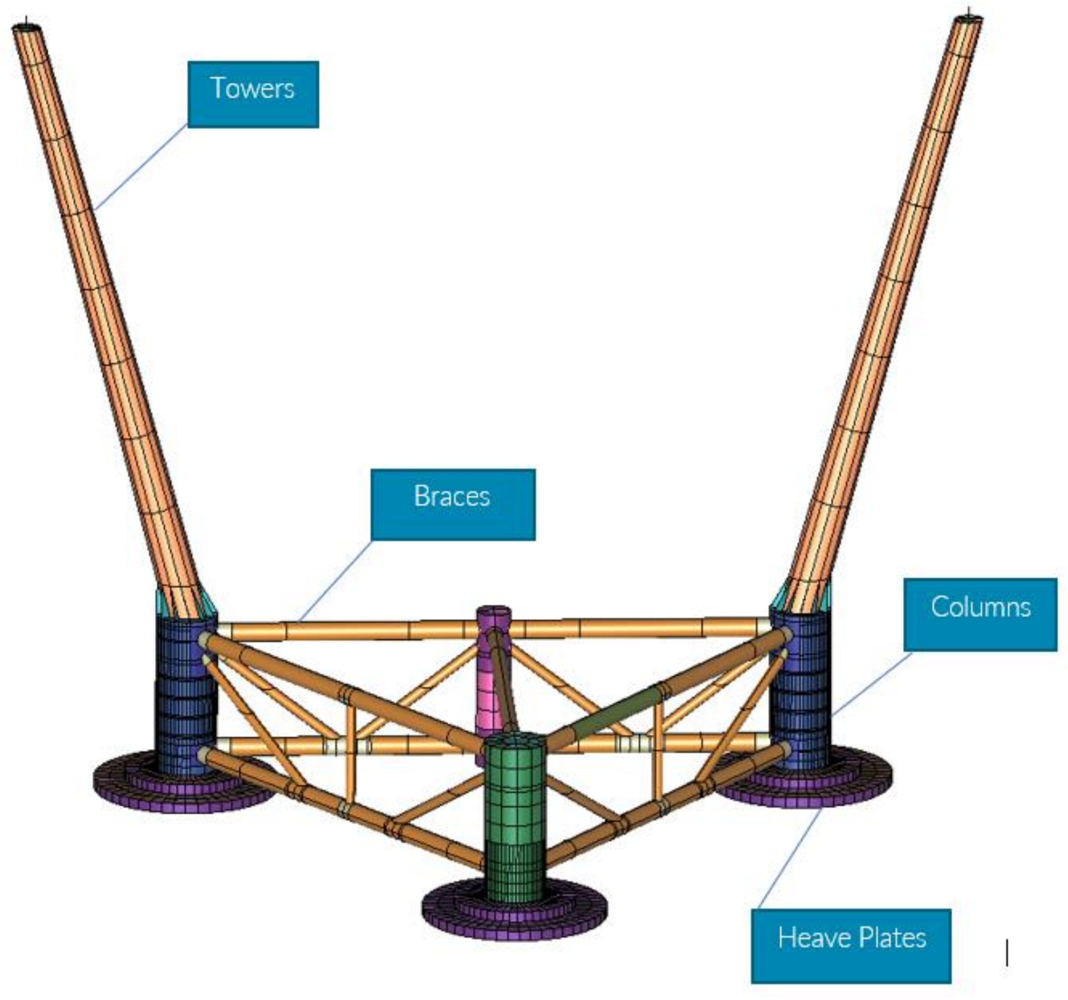
- To assess the feasibility and convenience of replacing steel with FRP in the construction of floating offshore wind farms, a cost-benefit analysis (CBA) was performed to demonstrate to what extent FRP addresses the needs (pains and gains) of the stakeholders, identified in the qualitative analysis.

- The offshore wind project object of the CBA consists of a sequence of activities necessary to create the floating wind farm, produce energy, export it to the grid so it can be consumed, and once the asset reaches the end of its useful life, to decommission it.

Development → Design → Manufacturing → Transport and installation → Operation and Maintenance → Decommissioning

- To be fully functional, the project must create a complete power generation plant with 200 wind turbines, and the necessary power export systems that transport the energy from the offshore wind turbines to the main grid onshore. For the CBA analysis, the system boundaries considered the floating platforms, with turbines, and the offshore substation (system A).

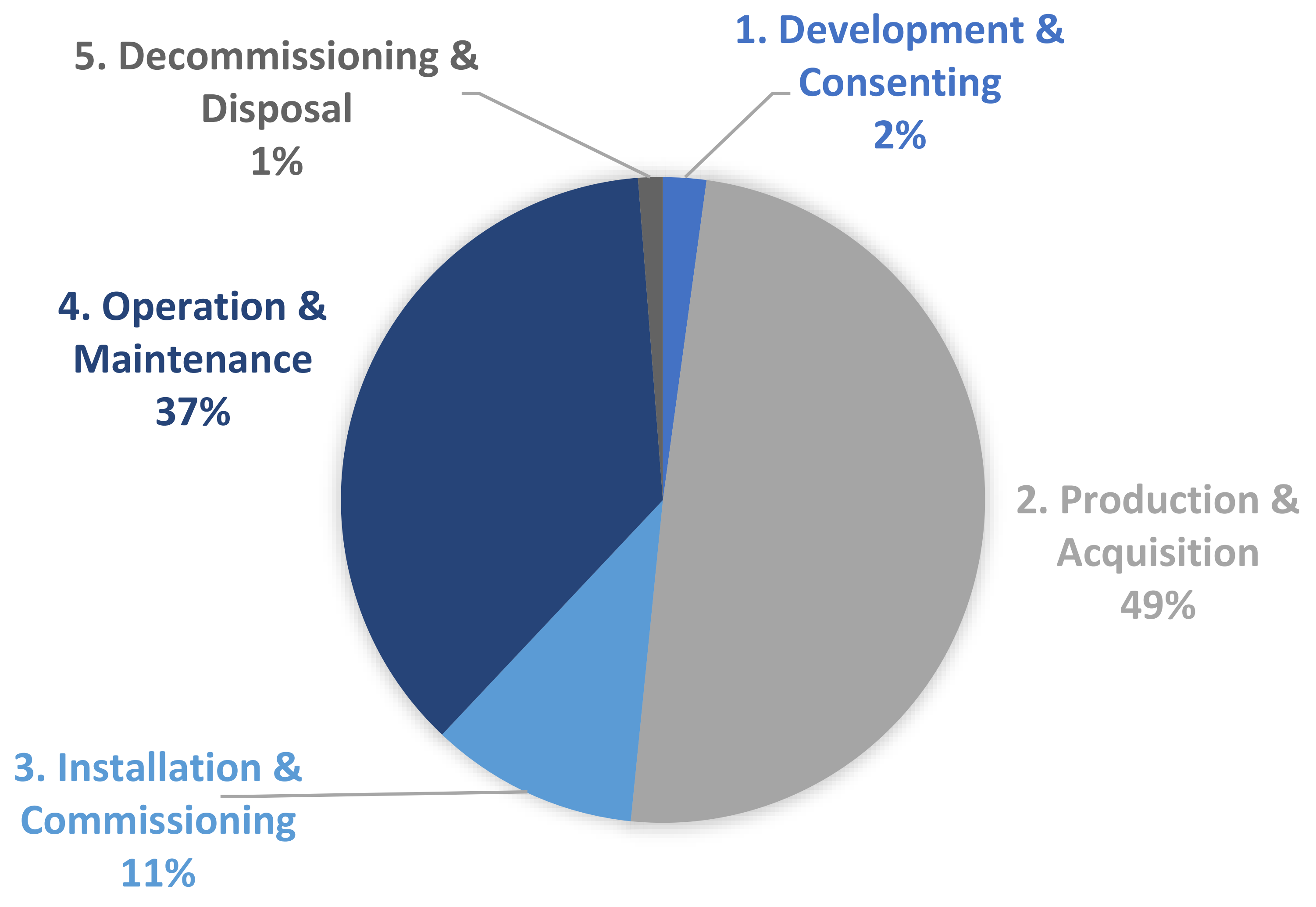


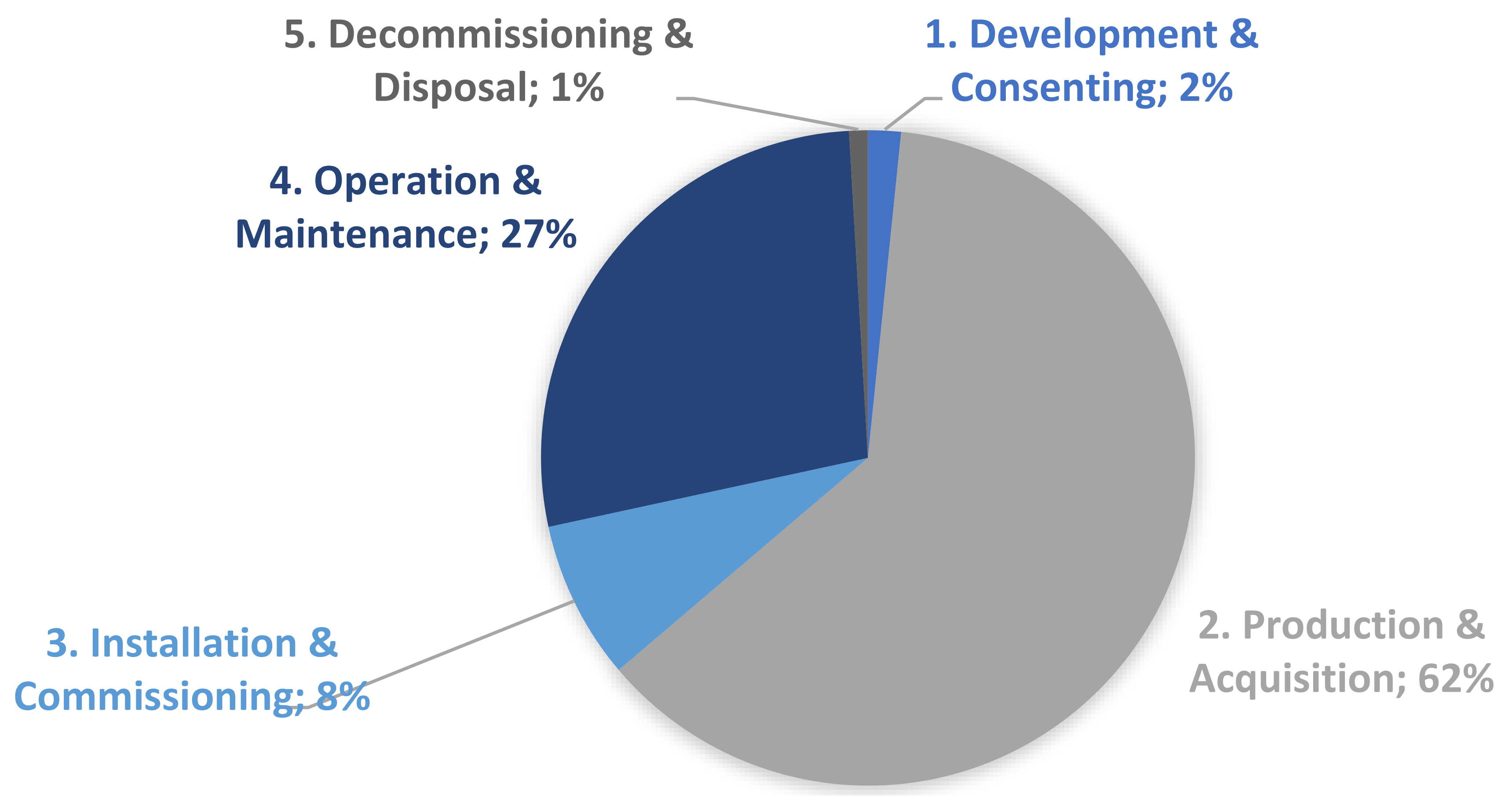


- The floating technology used is W2Power: a semi-submergible twin turbine platform developed by ENEROCEAN that, in this case, was dimensioned for a rated power of 12 MW on each floating platform.

T 1.1.2: Economic models in applications of composite structures and partial solutions in offshore wind

- Two hypothetical futures were analysed in the CBA process: the future with the innovative application of FRP (project case) and the future without FRP (base case using steel).
- The figure on the left presents the cost distribution in the base case (steel), while the right figure corresponds to the cost distribution in the project case (using FRP to construct the platform and towers).





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T 1.1.2: Economic models in applications of composite structures and partial solutions in offshore wind

- The Life Cycle Costs study performed with all necessary assumptions and estimations shows the FRP-based floating wind has a:
  - Capex 45% higher than using conventional materials
  - Opex 10% lower than using conventional materials

- The Financial profitability study performed with all necessary assumptions and estimations shows the FRP-based floating wind has a:
  - Net Present Value (NPV) very close to zero and a return on investment of about 8% (discount rate), meaning that it is almost profitable
  - LCOE 25% higher than using conventional materials

- It is necessary to remark that, although the full FRP version of W2Power floating platform has a higher cost in the 25 years of useful life, the properties of these materials present other advantages that could be key when choosing between steel and FRP.

- The higher durability of FRP will allow the design and construction of structures built to last 40 to 50 years. Moreover, maintenance strategies should be revised and consider the possibility of redesigning the floater for 40-50 years operation, replacing the turbines and other subsystems after 20-25 years.

- The optimal cost-benefit ratio could be obtained applying composites in some of the structural elements of the floating structure instead of the full platform.

T 1.1.2: Economic models in applications of composite structures and partial solutions in offshore wind

- From the sensitivity analysis it was concluded that the FRP-based wind farm would be profitable only reducing slightly the FRP price or the use of material:
  - With 350% FRP cost compared with the steel the NPV is positive
  - With 50% weight reduction of FRP-W2P compared to steel, the NPV is positive

- The multi-variable sensitivity analysis shows multiple scenarios with a simultaneous improvement of FRP price and use of material where the FRP project is more profitable than the equivalent in steel. For example:
  - 60% weight reduction and, at the same time, a 250% cost of FRP in relation to steel, would still result in a higher CAPEX, but considering OPEX savings, the overall result of the FRP project would be comparable to the equivalent project in steel, with a LCOE of approximately 75€/MWh.

Cost difference (k€)	FRP Price increase										
FRP Weight reduction	0%	50%	100%	150%	200%	250%	300%	350%	400%	450%	500%
80%	-184%	-176%	-168%	-160%	-152%	-144%	-136%	-128%	-120%	-112%	-104%
75%	-180%	-170%	-160%	-150%	-140%	-130%	-120%	-110%	-100%	-90%	-80%
70%	-176%	-164%	-152%	-140%	-128%	-116%	-104%	-92%	-80%	-68%	-56%
65%	-172%	-158%	-144%	-130%	-116%	-102%	-88%	-74%	-60%	-46%	-32%
60%	-168%	-152%	-136%	-120%	-104%	-88%	-72%	-56%	-40%	-24%	-8%
55%	-164%	-146%	-128%	-110%	-92%	-74%	-56%	-38%	-20%	-2%	16%
50%	-160%	-140%	-120%	-100%	-80%	-60%	-40%	-20%	0%	20%	40%
45%	-156%	-134%	-112%	-90%	-68%	-46%	-24%	-2%	20%	42%	64%
40%	-152%	-128%	-104%	-80%	-56%	-32%	-8%	16%	40%	64%	88%
35%	-148%	-122%	-96%	-70%	-44%	-18%	8%	34%	60%	86%	112%
30%	-144%	-116%	-88%	-60%	-32%	-4%	24%	52%	80%	108%	136%
25%	-140%	-110%	-80%	-50%	-20%	10%	40%	70%	100%	130%	160%
20%	-136%	-104%	-72%	-40%	-8%	24%	56%	88%	120%	152%	184%
15%	-132%	-98%	-64%	-30%	4%	38%	72%	106%	140%	174%	208%
10%	-128%	-92%	-56%	-20%	16%	52%	88%	124%	160%	196%	232%
5%	-124%	-86%	-48%	-10%	28%	66%	104%	142%	180%	218%	256%
0%	-120%	-80%	-40%	0%	40%	80%	120%	160%	200%	240%	280%

Current scenario (with the WP4 design parameters and D1.2 costs)

Improved scenario (lower material cost and higher weight reduction)

Task 1.2: Overview

Task 1.2. Tidal energy and other blue economy applications market analysis and prospective monitoring

Participants: TIDETEC (L), TSI, COMPASSIS, TUCO, BV

Study of the potential applications of the use of composite solutions for other blue economy applications complementary to offshore wind and shipping.

- Subtask 1.2.1. Market prospective for tidal use of composite solutions
- Subtask 1.2.2. Economic models for technical decision support in applications of composite structures and partial solutions in additional Blue economy markets.

T 1.2.1: Market prospective for the application of composite solutions in tidal & other blue economy

- Most of the investigations into FRP tidal energy sector are found in the blades. The rest of the turbine hardware is usually made in steel while the caisson impoundment is made in concrete. However, there are considerable corrosive and biofouling concerns that affect the turbine. Fibregy project aims at extending the use of FRP as structural material for Tidetec's turret.

- In the future, material efficiency will most likely improve, with a consequent reduction in material demand per turbine. Since a significant portion of the costs in a turbine come from the weight of the steel being used, it is likely that there will be measured efforts to improve more lightweight materials while maintaining structural integrity.

- The results of FIBREGY project will provide good background into alternative material selection, allowing a basis for the validation of utilizing composite materials in the marine market. Addressing turbine manufacturers and operations in the value chain.

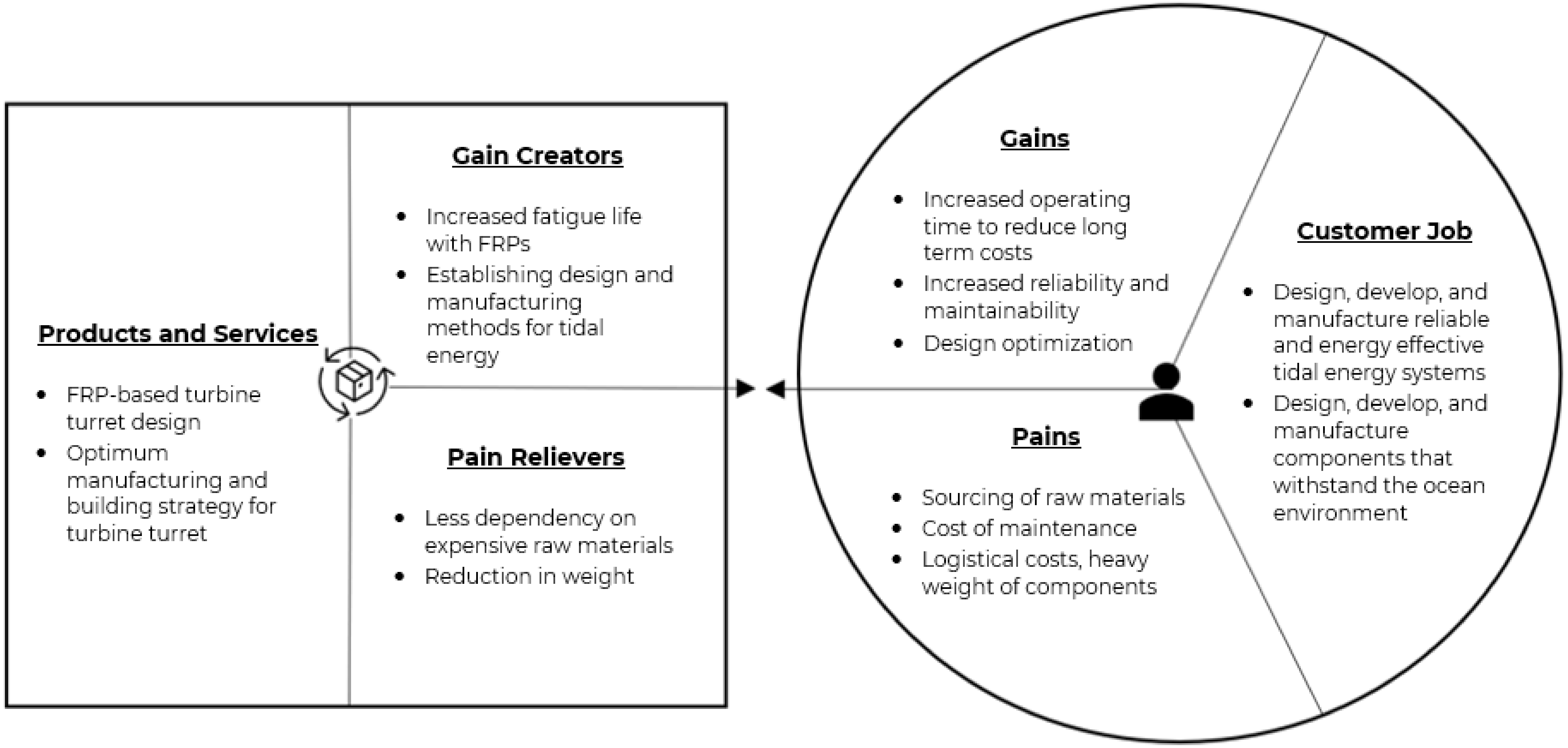
- To get a general coverage of the blue economy sector, six areas were chosen: aquaculture, coastal protection, desalination, hydrogen generation, maritime transport and shipbuilding/ship repair. Within all these sectors, interest and value in using FRP materials varies, therefore there will be brief points based on some of these sectors to give a general impression.

- Within the blue economy there is a wide range of interests into utilizing FRP materials. Shipbuilding/ship repair is one sector where there has been particular investment into the application of FRP materials to create lightweight and corrosion resistant vessels.

- The aquaculture is one of the largest marine industries with both onshore and offshore potential. However, the cost of offshore aquafarming is substantially larger than onshore (over 3x the cost). The significance of any means of lowering costs through FRP materials cannot be overlooked especially as land space becomes less available.

T 1.2.1: Market prospective for the application of composite solutions in tidal & other blue economy

- Based on the needs of the objective market niches identified in the strategic analysis, and on the qualitative benefits of FRP technology, a Value Proposition Canvas was elaborated for each potential customer niche.
- The Value Proposition canvas is a graphic representation of the market needs (circle) and how the solution satisfies them (square). The one on the right corresponds to the value proposition for manufacturers working in the tidal energy industry.



T 1.2.1: Market prospective for the application of composite solutions in tidal & other blue economy

- The use of lightweight materials in mainly being investigated in the blades of tidal turbines. The opportunity to use FRPs in a market with such upcoming growth could provide a foundation for the way that tidal energy projects are designed. The most notable existing tidal range project, La Rance Tidal Power Plant, had 12,000 tons of steel, including 12 of the 24 total turbines which were made of steel

- While there is significant potential to generate power in the tidal energy sector, the world is just beginning to put serious effort into investing in this technology. This means that there is a considerable amount of growth in the market. Estimates of the theoretical potential of ocean energy ranges from 20,000 TWh to 80,000 TWh per year and as of 2020; the installed capacity of all ocean technologies was 535 MW.

- Offshore hydrogen generation: there is a lot of potential to include composite materials in the new ideas and structures that might be implemented for these offshore platforms. Additionally, an offshore hydrogen production can be combined with a wind turbine farm that makes use of the advantages that composites can offer.

- Shipping industry: there has already been significant work into the use of FRP materials in the shipping industry. The weight reduction of ships creates a huge cost advantage in these sectors. Reducing the weight of a 40-foot shipping container by 20% would result in USD 28 billion in fuel savings over its 15-year lifetime.

- Aquaculture: the amount of land-based aquaculture farms are approaching its limit and the rising demand is pushing the sector towards offshore solutions. This move would be the critical time to introduce composite materials into the aquaculture sector as their advantages are significant in ocean environments.

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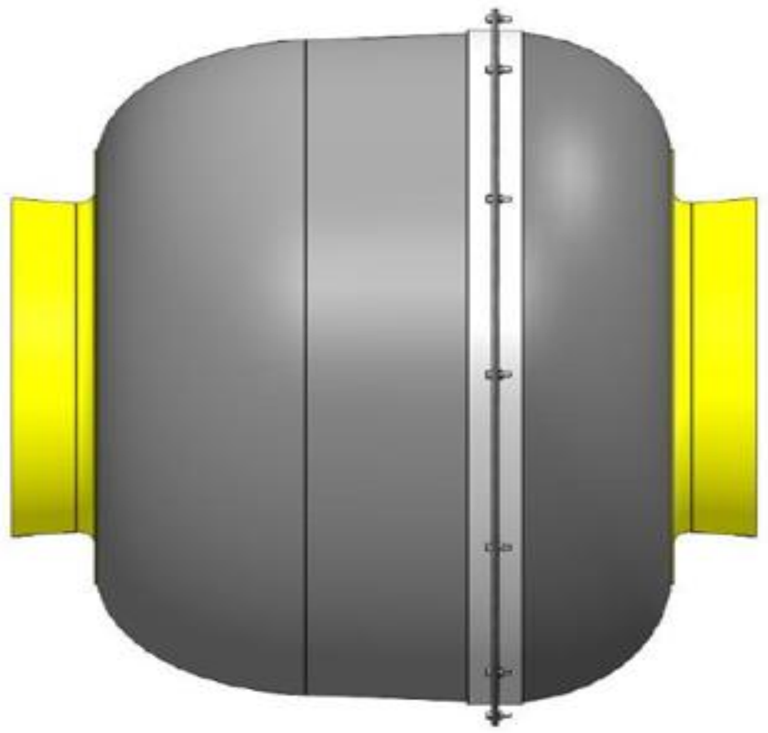
T 1.2.2: Economic models in applications of composite structures and partial solutions in tidal & blue economy

- To assess the feasibility and convenience of replacing steel with FRP in the construction of tidal energy sector, a cost-benefit analysis (CBA) was performed to demonstrate to what extent FRP addresses the needs (pains and gains) of the stakeholders, identified in the qualitative analysis.

Development → Design → Manufacturing → Transport and installation → Operation and Maintenance → Decommissioning

- For this tidal barrage we assume the turbines are placed in a lagoon that has a surface area of 13.600 m2. At this site the mean tidal range is 5m and we are using ten Ø0,34m turbines in the system.



- This analysis will use Tidetec's turret as part of the design of the plant. This turret holds the turret inside and allows the turbine to be turned to allow for more efficiency in generating power in both directions of the tide. For the FIBREGY project, this turret holds a model turbine with a runner diameter of Ø0,34, although the design is scalable for larger turbines as well.

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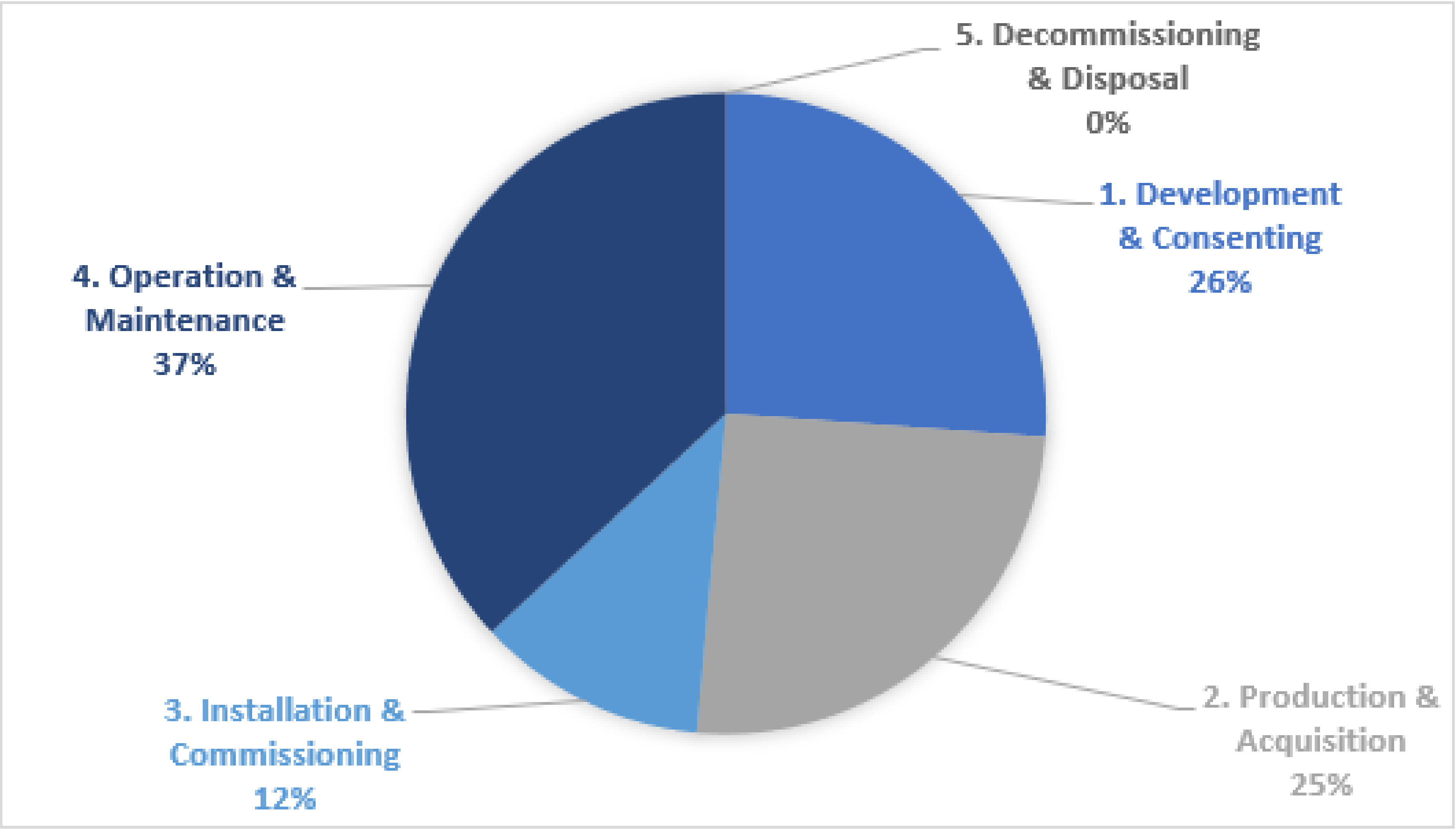
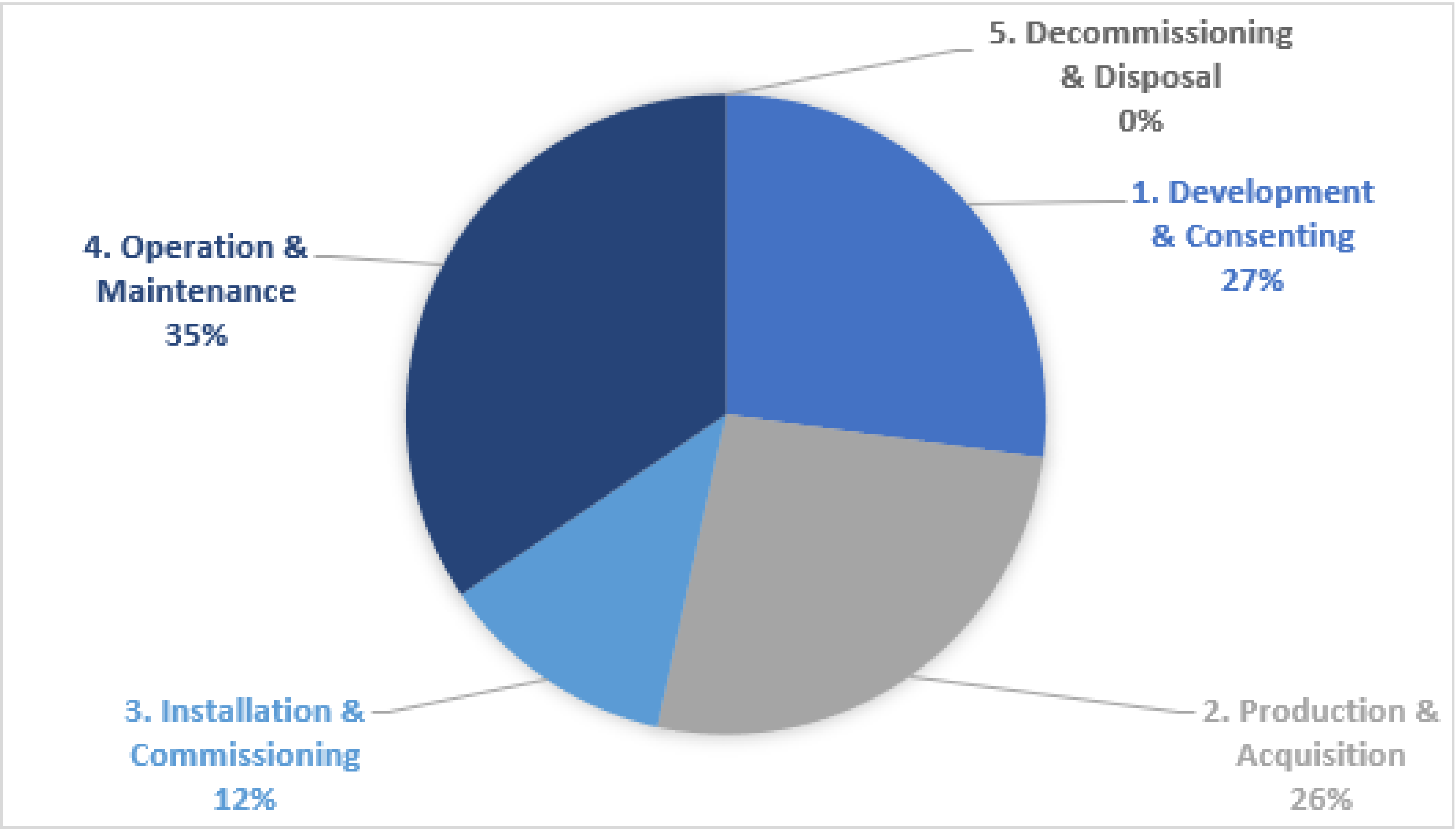
T 1.2.2: Economic models in applications of composite structures and partial solutions in tidal & blue economy

- Two hypothetical futures were analysed in the CBA process: the future with the innovative application of FRP (project case) and the future without FRP (base case using steel).
- The figure on the left presents the cost distribution in the base case (steel), while the right figure corresponds to the cost distribution in the project case (using FRP to construct the turret).





T 1.2.2: Economic models in applications of composite structures and partial solutions in tidal & blue economy

- The results show that, with all the assumptions and estimations made, the OPEX decreases by 10% from using FRP materials. Currently these tidal installations expected to last around 100 years with steel structures (including a replacement at 50 years). As there has been very little testing in this sector it is unclear exactly how long the use of FRP materials could extend this lifetime. However, it is clear that due to the natural of the turbines being continuously submerged, there can be significant gains in improving the corrosion resistance and biofouling using FRP materials.

- Overall, the results show us that adjustments need to be made to consider real scale turbines, which can potentially give us more realistic ideas of the profitability of a tidal range project. However, it will continue to be a challenge in this sector with so little data from previous works.

- The FIBREGY project is using a demonstrator size turbine of Ø0,34 m to investigate here. When in reality, real scale turbines are expected to be 2m or more in diameter. This means that the amount of energy they can create is significantly higher and less pumps would be needed to discharge the same amount of water in a reservoir.

- With this in mind it would be more beneficial for a tidal range project to investigate a full-scale size turbine to get a better estimation of what the cost benefits would be. The optimal cost-benefit ratio could be obtained applying composites in some of the structural elements instead of on the full structure.

Task 1.3: Overview

Task 1.3. FRP Engineering services, structural analysis and CAE solutions applications market analysis and prospective monitoring

Participants: TSI (L), COMPASSIS, CIMNE, ENEROCEAN, IXBLUE, TUCO, CORSO, BV

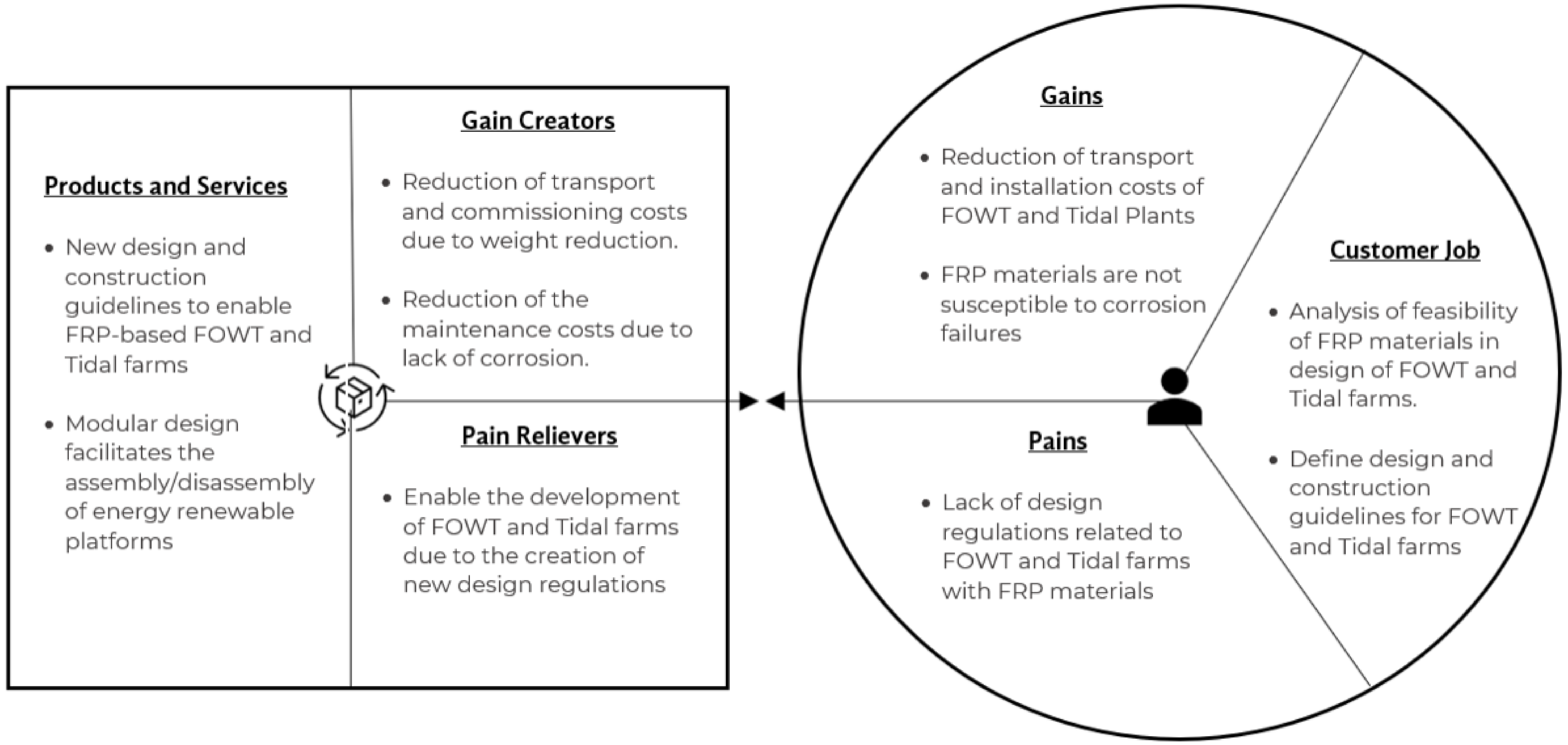
Study of the engineering support solutions, software and services, needed for the application of FRP and other composite solutions for the blue economy applications.

- Subtask 1.3.1. Market prospective for engineering solutions
- Subtask 1.3.2. Economic models for technical decision support in engineering solutions

T 1.3.1: Market prospective for engineering solutions

ENGINEERING SERVICES FOR WIND FARM AND TIDAL PLANT OWNERS

- EU companies lead in engineering services for wind and tidal plants.
- New rules needed for FRP designs in wind and tidal plants.
- Benefits of FRP materials:
  - Corrosion resistance reduces operational costs.
  - Weight reduction lowers transport and installation costs.
  - Thermoplastic resins aid recycling for sustainability.
  - Customizable visual appearance.
  - Modularity facilitates construction and decommissioning.
  - Improved comfort for O&M technicians compared to steel platforms.



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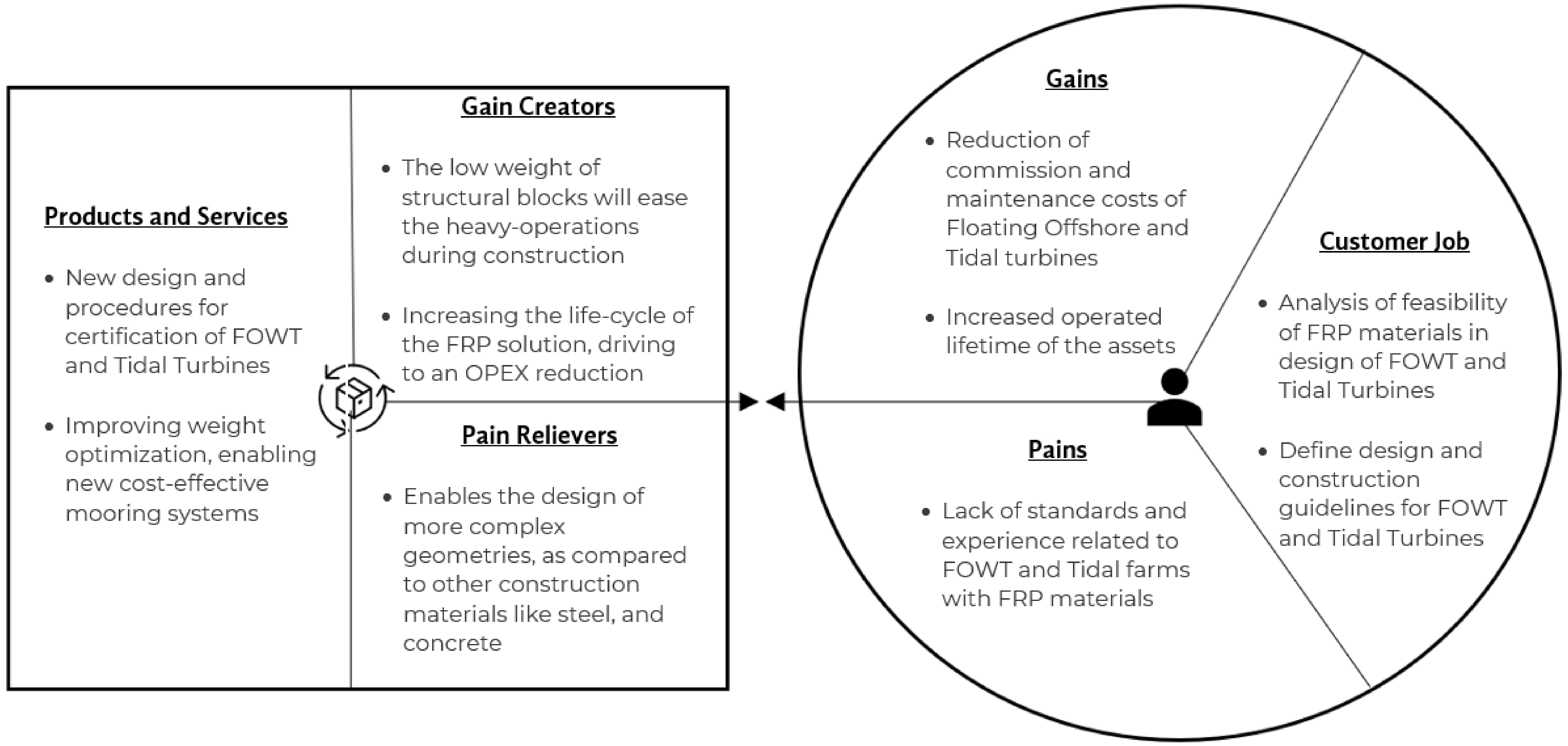
T 1.3.1: Market prospective for engineering solutions

ENGINEERING SERVICES FOR WIND/TIDAL TECHNOLOGY DEVELOPERS

- European companies lead R&D innovation projects for floating offshore and tidal platforms.
- Significant R&D investments required, but lack of experience with FRP materials and related standards/regulations hinders investment.
- Wind/Tidal Technology Developers are major customers for engineering services in floating offshore and tidal energy sectors.
- Implementation of FRP materials enables:
  - Improved weight optimization for cost-effective mooring systems.
  - Increased solution lifespan due to corrosion resistance, reducing OPEX.
  - Optimized disassembly and recycling, enhancing sustainability.
- FRP manufacturing versatility allows for complex geometries compared to steel and concrete.
- Modular construction techniques reduce manufacturing costs, while low weight eases heavy-lift operations during construction.



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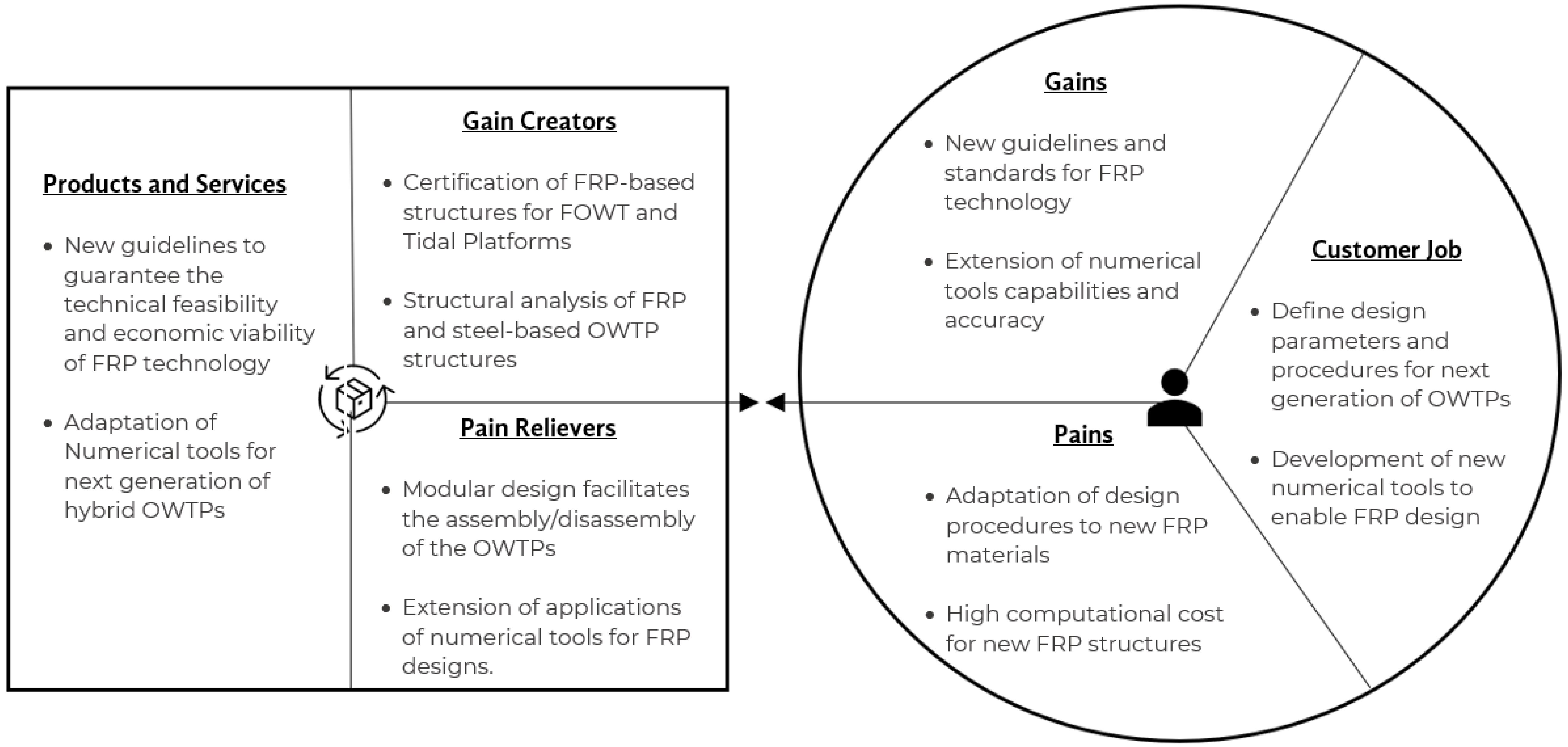
T 1.3.1: Market prospective for engineering solutions

ENGINEERING SERVICES FOR OTHER ENGINEERING FIRMS

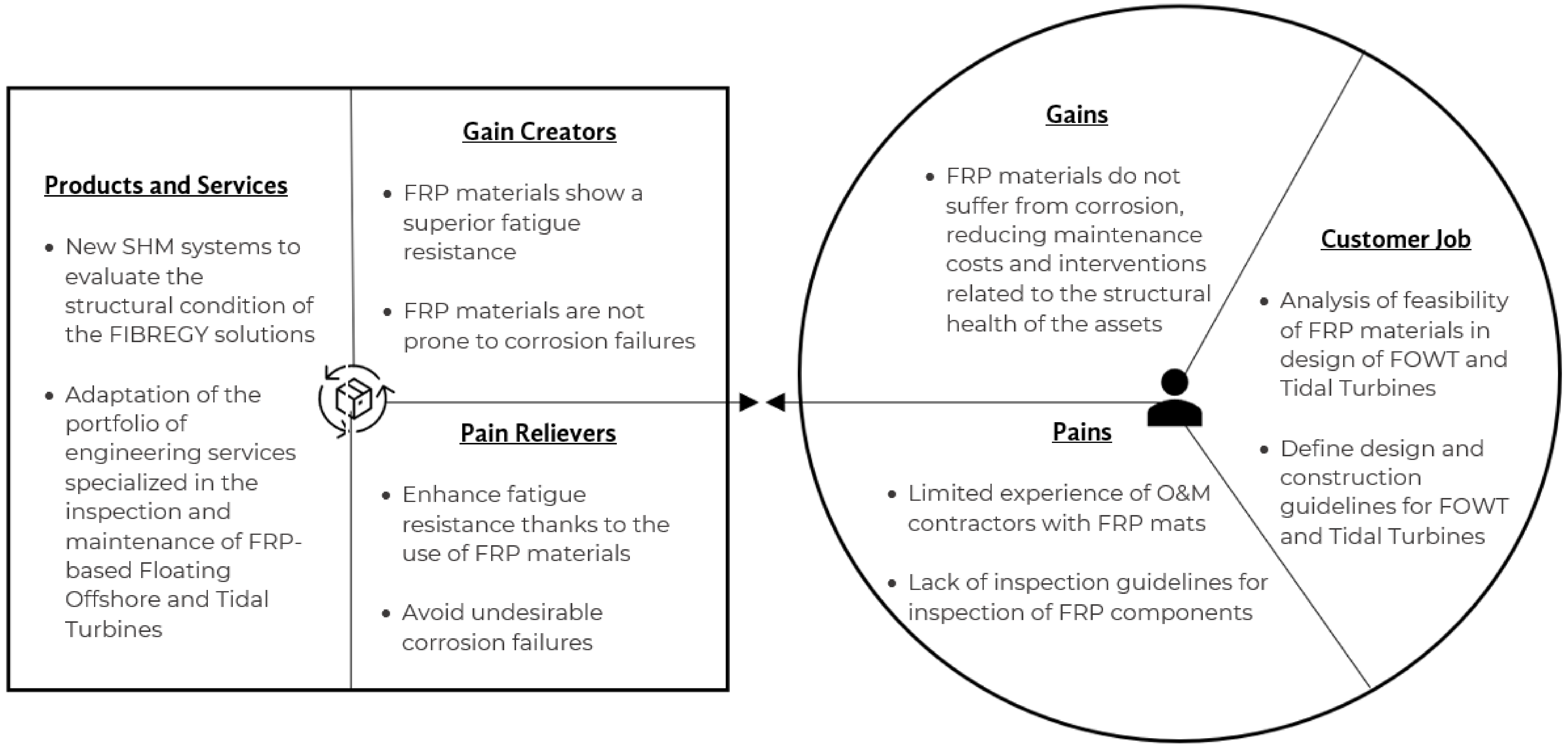
- Engineering firms are potential customers for new technologies developed in the FIBREGY project.
- To enable the EU to lead in the construction of wind/tidal farms using lightweight materials, several approaches can be taken:
  - Develop new numerical tools for designing FRP structural components for FOWT and tidal platforms.
  - Reduce costs and validate new materials. FRP materials typically have higher materials and manufacturing costs compared to conventional materials like steel and concrete. The maritime industry is often conservative in adopting new materials like FRP until they are proven and validated.



T 1.3.1: Market prospective for engineering solutions

ENGINEERING SERVICES TO O&M CONTRACTORS

- Engineering firms are potential customers for new technologies developed in the FIBREGY project.
- To enable the EU to lead in the construction of wind/tidal farms using lightweight materials, several approaches can be taken:
  - Develop new numerical tools for designing FRP structural components for FOWT and tidal platforms.
  - Reduce costs and validate new materials. FRP materials typically have higher materials and manufacturing costs compared to conventional materials like steel and concrete. The maritime industry is often conservative in adopting new materials like FRP until they are proven and validated.



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T 1.3.2: Economic models in engineering solutions

The engineering services that the market offer to the Floating Offshore Sector and Tidal Energy Sector can be summarized as follows:

- Design and Development of Floating Wind and Tidal Platforms:
  - Involves hydrodynamic and structural design calculations, mooring design, stability calculations, and cost analysis.
  - Focus on capital costs (CapEx) and life cycle costs (OpEx) including inspection and maintenance.
- Transport, Installation, and Commissioning of Wind/Tidal Farms:
  - Covers design basis, construction, installation, repair, and repowering of wind and tidal turbines.
  - Includes project management and other related services.
- Standardization and Certification:
  - Provides guidance on regulatory compliance and supervision of engineering contractors.
  - Develops new guidelines/regulations for next-generation offshore wind and tidal turbines.
- Operation and Maintenance:
  - Conducts factory and site acceptance tests, installs inspection and monitoring systems based on SCADA, IoT, etc.
  - Analyzes key performance indicators (KPIs), creates digital twin models, and offers other maintenance services.
- Measurements and Tests:
  - Conducts small- and medium-scale testing in large-scale testing on ocean platforms.
  - Includes services like underwater radiated noise testing, structural health monitoring, and vibration measurements.
- Analysis and Simulation:
  - Performs structural and hydrodynamic simulation, earthquake simulation, and modal and static analysis.
  - Correlates test data with finite element model (FEM) and numerical simulation for accurate analysis.
- Marketing and Sales:
  - Conducts market and technical assessments, business and financial analysis, and manages intellectual property.
- Decommissioning, Disposal, and Recycling:
  - Identifies hazardous materials, salvages high-value materials, and handles decommissioning and recycling of wind and tidal components.

Task 1.4: Overview

Task 1.4. FIBREGY Global Business Plan

Participants: COMPASSIS (L), IXBLUE, TUCO, CORSO, TSI, ENEROCEAN, TIDETEC

The task has produced:

- Business Models: A Business Model Canvas has been completed and described in detail for each objective market and value proposition.
- Business Plans: A complete business plan has been elaborated, in order to guide the exploitation of the project results for each market. Such plan includes the information produced in the **market analysis** performed in D1.1 , a description of the **business objectives**, the **structure of the organization** (resources, partnerships…), the **financial details** (including the cost-benefit analysis results retrieved in D1.2), and the tasks to be undertaken to achieve those objectives, including a **Gantt diagram**.

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Task 1.4: Business canvas models

BMC: Floating Offshore Wind (summary)

Key Partners
- Wind Turbine Manufacturers
- Engineering and Design Firms
- Construction Contractors
- Operations and Maintenance Service Providers
- Grid Operators

Key Activities
- Project Development
- Engineering and Design
- Construction and Installation
- Operations and Maintenance
- Electricity Generation and Distribution

Key Resources
- Floating Wind Turbines
- Infrastructure
- Personnel

Value Propositions
- Clean Energy
- Energy Security
- Job Creation
- Innovation

Customer Relationships
- Transactional
- Collaborative

Channels
- Direct Sales
- Government Contracts
- Investment Vehicles

Customer Segments
- Energy Companies
- Government Entities
- Investors

Cost Structure
- Turbine Procurement and Installation
- Operations and Maintenance
- Personnel
- Financing Costs

Revenue Streams
- Electricity Sales
- Government Incentives
- Investment Returns

BMC: Tidal & Blue Economy (summary)

Key Partners
- Tidal Turbine Manufacturers
- Engineering and Design Firms
- Construction Contractors
- Aquaculture Companies
- Sustainable Tourism Companies
- Government Entities

Key Activities
- Project Development
- Engineering and Design
- Construction and Installation
- Integration with Aquaculture
- Sustainable Tourism Development

Key Resources
- Tidal Turbines
- Infrastructure
- Aquaculture Infrastructure
- Marine Ecosystems
- Personnel

Value Propositions
- Clean Energy
- Sustainable Aquaculture
- Sustainable Tourism
- Innovation

Customer Relationships
- Transactional
- Collaborative

Channels
- Direct Sales
- Government Contracts
- Partnerships

Customer Segments
- Energy Companies
- Aquaculture Companies
- Sustainable Tourism Companies
- Government Entities

Cost Structure
- Turbine Procurement and Installation
- Operations and Maintenance
- Personnel
- Aquaculture Development
- Sustainable Tourism Development

Revenue Streams
- Electricity Sales
- Aquaculture Sales
- Government Incentives

BMC: Design & Engineering (summary)

Key Partners
- Suppliers
- Research Institutions
- Regulatory Bodies
- Industry Associations
- Construction Companies

Key Activities
- R&D
- Engineering Design
- Collaboration
- Project Management
- Continuous Learning

Key Resources
- Skilled Professionals
- Software Tools
- Industry Knowledge
- Strategic Partnerships
- Network

Value Propositions
- Customized Design Solutions
- Sustainability
- Cost-effectiveness
- Compliance
- Innovation

Customer Relationships
- Personalized Consulting
- Long-term Partnerships
- Communication
- Collaboration
- Feedback

Channels
- Online Platforms
- Conferences/Trade Shows
- Industry Associations
- Direct Sales
- Referrals

Customer Segments
- Aquaculture Companies
- Marine Renewable Energy Companies
- Coastal Engineering Companies
- Marine Transportation Companies

Cost Structure
- Employee Salaries
- R&D Expenses
- IT Infrastructure
- Marketing
- Maintenance
- Material/Equipment Costs

Revenue Streams
- Project-based Fees
- Licensing/Royalties
- Maintenance Contracts
- Value-added Services

Task 1.4: Global Business Plans: Financial Plans

Financial Plan: Floating Offshore Wind

For a new FOW farm including FRP-based platform solution as described in D1.2 Cost-benefit analysis stakeholder report

INVESTMENT/COSTS

Life Cycle Stage	Cost concept	CAPEX (M€)	OPEX (M€)	TOTAL (M€)
1. Development & Consenting	CONFIDENTIAL			
2. Production & Acquisition				
3. Installation & Commissioning				
4. Operation & Maintenance				
5. Decommissioning & Disposal				
TOTAL				

SALES PLAN/REVENUES

	TOTAL	Years 0	1	2	...	25
Energy sale	CONFIDENTIAL					
Total Revenue						
Operation costs						
Transmission charges						
Corrective maintenance costs						
Preventive maintenance costs						
Total Operating Costs						
Net revenues						

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Task 1.4: Global Business Plans: Financial Plans

Financial Plan: Tidal & Blue Economy

Tidetec's FRP-based turret, as part of the tidal barrage plant, as described in D1.2 Cost-benefit analysis stakeholder report.

SALES PLAN/REVENUES

	TOTAL	0	1	2	...	100
Energy sale	CONFIDENTIAL					
Total Revenue						
Total Operation and Maintenance Costs						
Decommissioning Cost						
Net revenues						

INVESTMENT/COSTS

Cost concept	Comments	Unit Cost (€)	Proposed Tidal Barrage Cost (€)
Turret	Composite material (SIGRAPREG)	CONFIDENTIAL	
	Tooling costs and others for all housing (steel)		
	Inserts, flanges, fairings and others		
	Curing costs		
Turbine and generator			
Structural frame			
TOTAL			

Cost concept	Proposed tidal barrage cost (€) for 100 years in steel	Reduction for FRP materials	Proposed tidal barrage cost (€) for 100 years in FRP
Operations and Maintenance	CONFIDENTIAL		
TOTAL			

Life Cycle Stage	Cost concept	CAPEX (€)	OPEX (€)	TOTAL (€)
1. Development & Consenting	1.1. Management and consenting	CONFIDENTIAL		
	1.2. Surveys			
	1.3. Engineering			
2. Production & Acquisition	2.1 Turret			
	2.2 Turbine and generator			
	2.3 Structural frame			
3. Installation & Commissioning	3.1 Installation and Commissioning			
4. Operation & Maintenance	4.1 Operations			
5. Decommissioning & Disposal	5.1 Decommissioning			
TOTAL				

Task 1.4: Global Business Plans: Financial Plans

Financial Plan: Design and Engineering

Trending income models for engineering/design tools

ONLINE PLATFORM

+ VALUE AND INCOME OPPORTUNITIES

- SUSCRIPTION MODEL
- FREEMIUM
- USAGE-BASED

APP PORTFOLIO

- MARKETPLACE of perpetual licenses.

PLUGIN SUITE

- MARKETPLACE of perpetual licenses.

SaaS

+ VALUE AND INCOME OPPORTUNITIES

- SUSCRIPTION MODEL
- FREEMIUM
- USAGE-BASED

Simulation software global market (Font: Market research Future)

70% Software

Growth in this sector is driven by the FEA (finite element analysis) segment and its applications in the automotive, aerospace, defense and electronics industries.

30% Services

Design, consulting and training services are included.
Greater growth is expected in the coming years in this sector driven by the demand for virtual solutions for the development of products and processes by governments and private companies.

TOTAL REVENUE IN 2021

Dassault Systèmes	€4.5 bn
AUTODESK	€4.5 bn
Ansys	€1.9 bn
Bentley	€1.02 bn
ALTAIR (ONLY FORWARD)	€0.58 bn

→ **€12,5 Bn** COMPOUND VALUE

€31 Bn

Total revenue of the 150 leading consulting firms in Europe in 2021.

SWECO, wsp, RAMBØLL, SNC·LAVALIN, MOTT MACDONALD, ARUP

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Task 1.4: Global Business Plans: Financial Plans

Tidal & Blue Economy

	Years					
	TOTAL	0	1	2	...	100
Total revenues (k€)						
Total inflows (k€)						
Total operating costs (k€)						
Initial investment (k€)						
Total outflows (k€)						
Net cash flow (k€)						
FNPV (k€)						
FRR (%)						

CONFIDENTIAL

Floating Offshore Wind

	Years					
	TOTAL	0	1	2	...	25
Total revenues (k€)						
Total inflows (k€)						
Total operating costs (k€)						
Initial investment (k€)						
Total outflows (k€)						
Net cash flow (k€)						
FNPV (k€)						
FRR (%)						
LCOE (€/MWh)						

CONFIDENTIAL

Ratios Analysis and Financial Profitability

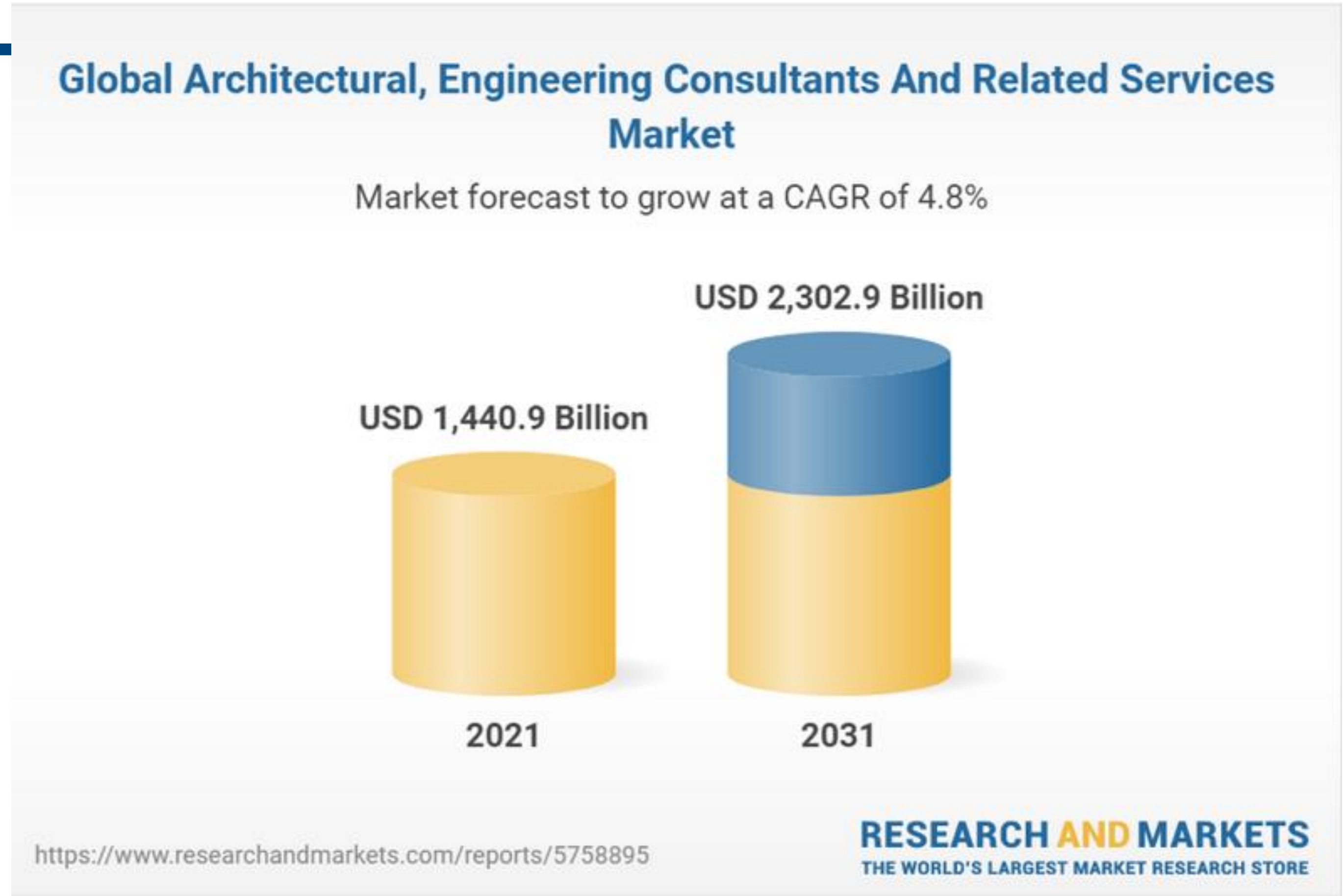
- Leveraged Cost Of Energy (LCOE)
- Financial Net Present Value (FNPV)
- Financial Rate of Return on investment (FRR)
- Compound Annual Growth Rate (CAGR)

Design and Engineering

GROWTH OF THE GLOBAL SIMULATION SOFTWARE MARKET

+13,10%

Expected CAGR 2023 to 2032.



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Task 1.4: Global Business Plans: Activities calendar

Activities calendar: GANTT

Floating Offshore Wind

ACTIVITY	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
Market Research and Feasibility Study									
Regulatory Approvals									
Design and Engineering Planning									
Prototype Development (FRP Platforms)									
Material Sourcing and Supplier Setup									
Manufacturing Facility Setup									
FRP Production and Platform Assembly									
Quality Control and Testing									
Marketing and Pre-sales									
Launch of Floating Wind Platforms									
Continuous Improvement and Innovation									

Tidal & Blue Economy

ACTIVITY	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
Market Research and Feasibility Study									
Regulatory Approvals									
Blue Economy Integration Planning									
Design and Engineering Planning									
Prototype Development (Tidal Turbines)									
Material Sourcing and Supplier Setup									
Manufacturing Facility Setup									
Tidal Turbine Production and Assembly									
Quality Control and Testing									
Marketing and Pre-sales									
Launch of Tidal Turbines and Blue Economy Solutions									
Continuous Improvement and Innovation									

Design and Engineering

ACTIVITY	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
Market Research and Feasibility Study									
Regulatory Approvals									
Business Model Development									
Design and Engineering Planning (floating offshore platforms)									
Prototype Development (floating offshore platforms)									
Blue Economy Integration Planning									
Design and Engineering Planning (Tidal Turbines)									
Prototype Development (Tidal Turbines)									
Material Sourcing and Supplier Setup									
Manufacturing Facility Setup									
Production of Wind Platforms (FRP)									
Tidal Turbine Production and Assembly									
Quality Control and Testing									
Marketing and Pre-sales									
Launch of Projects									
Continuous Improvement and Innovation									

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