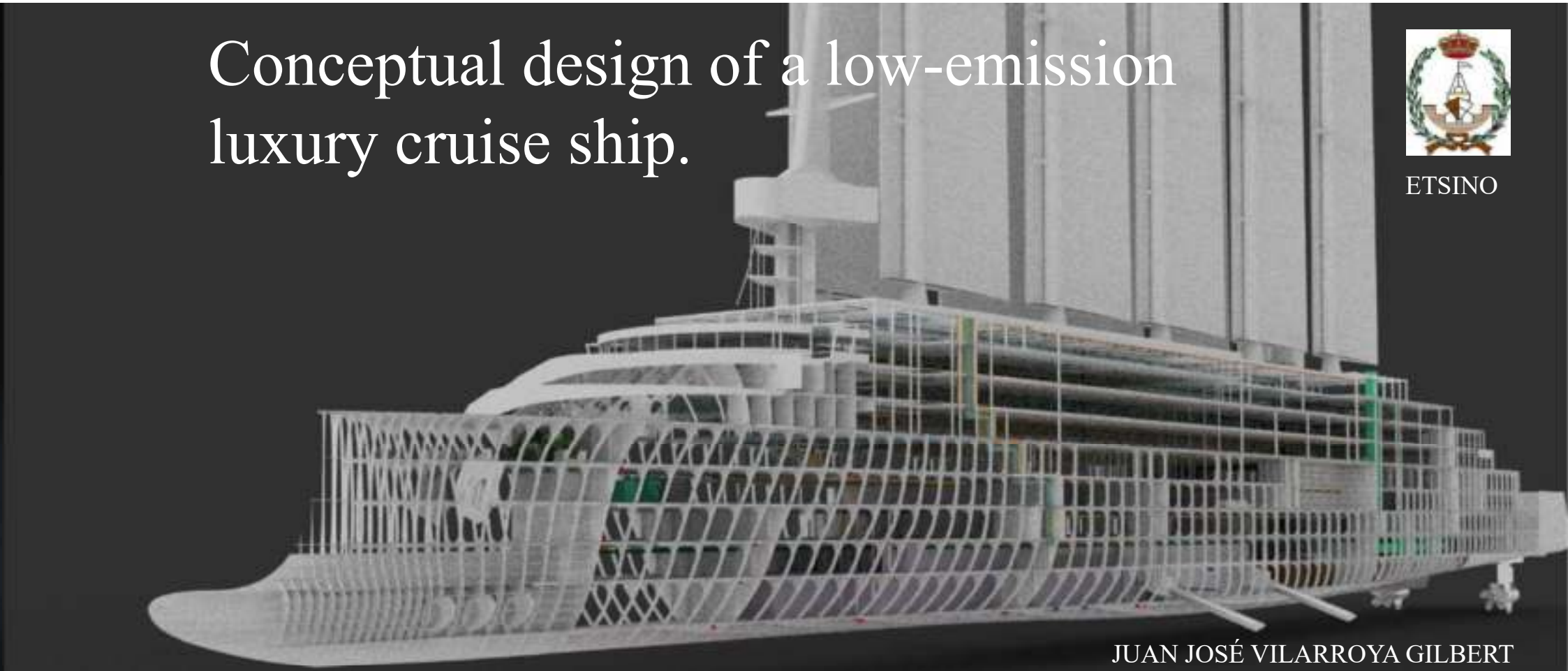
Conceptual design of a low-emission luxury cruise ship.

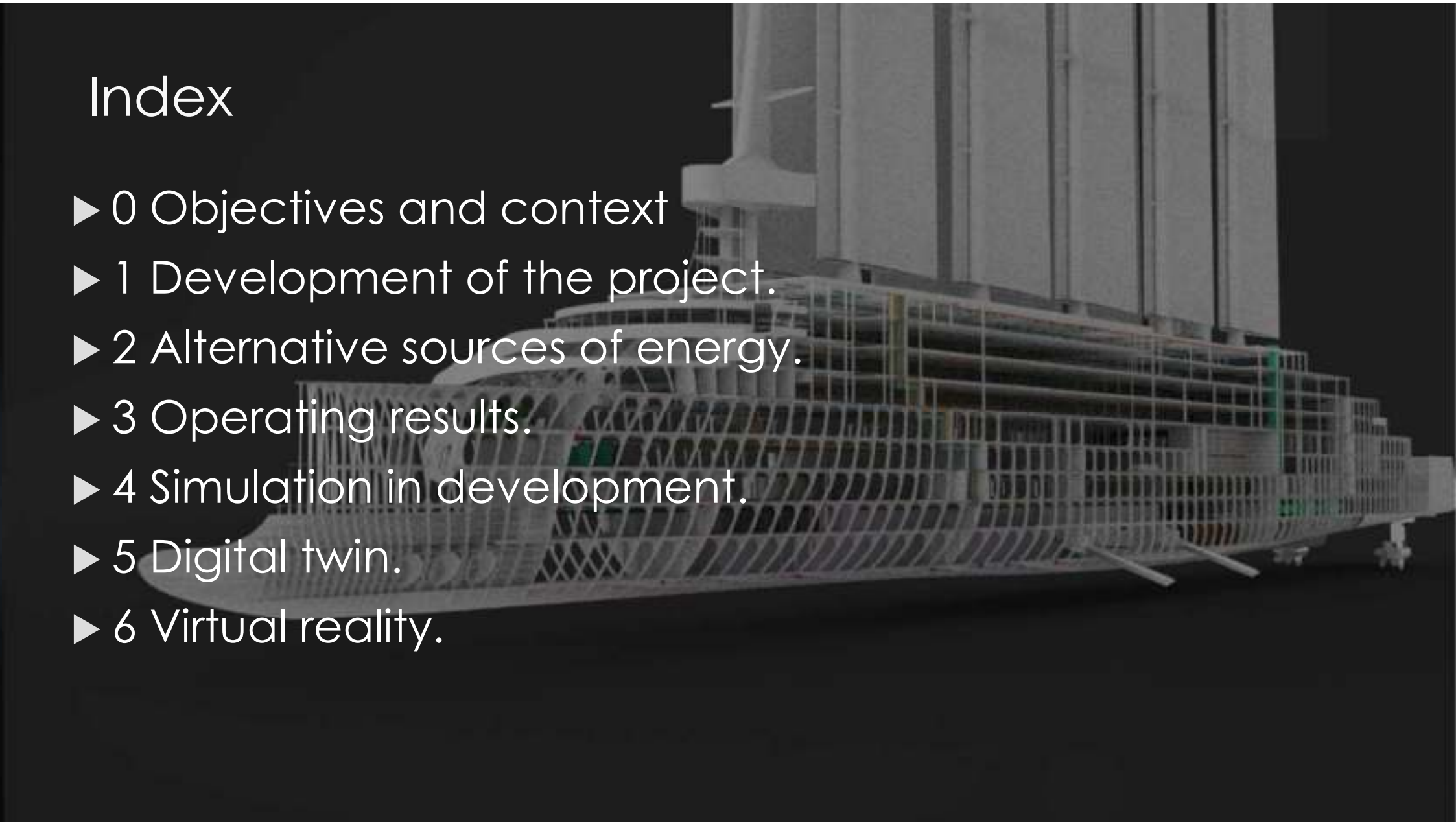


ETSINO

JUAN JOSÉ VILARROYA GILBERT

MASTER'S THESIS

Universidad Politécnica de Cartagena



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0 objetivos y contexto

- In recent years there has been an increased need to be able to reduce its harmful effects. These initiatives have had a greater impact on the cruise industry with the introduction of new energy sources (such as LNG).

0 Objectives and context

- **Main Objectives:**
- **Vessel for 400 passengers**
- **Using Alternative Sources**
- **Use of the latest technologies in the design of the project (industry 4.0) (simulation, digital twin and virtual reality)**

1 Development of the project

Study of art

- A study of the different technologies to be applied will be made:

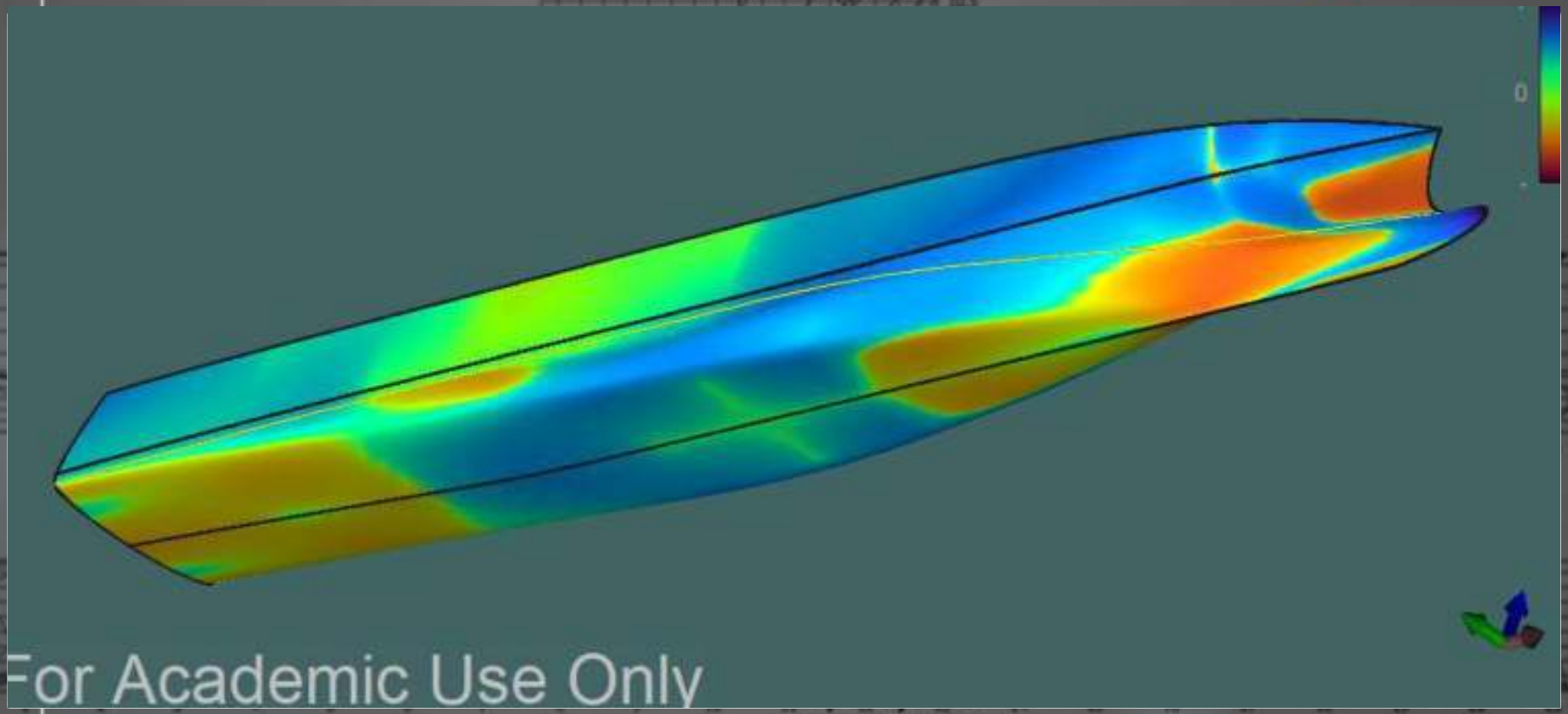
1 Development of the project

Conceptual design

- Once the technology is known, an initial design of the vessel will be carried out.

1 Development of the project

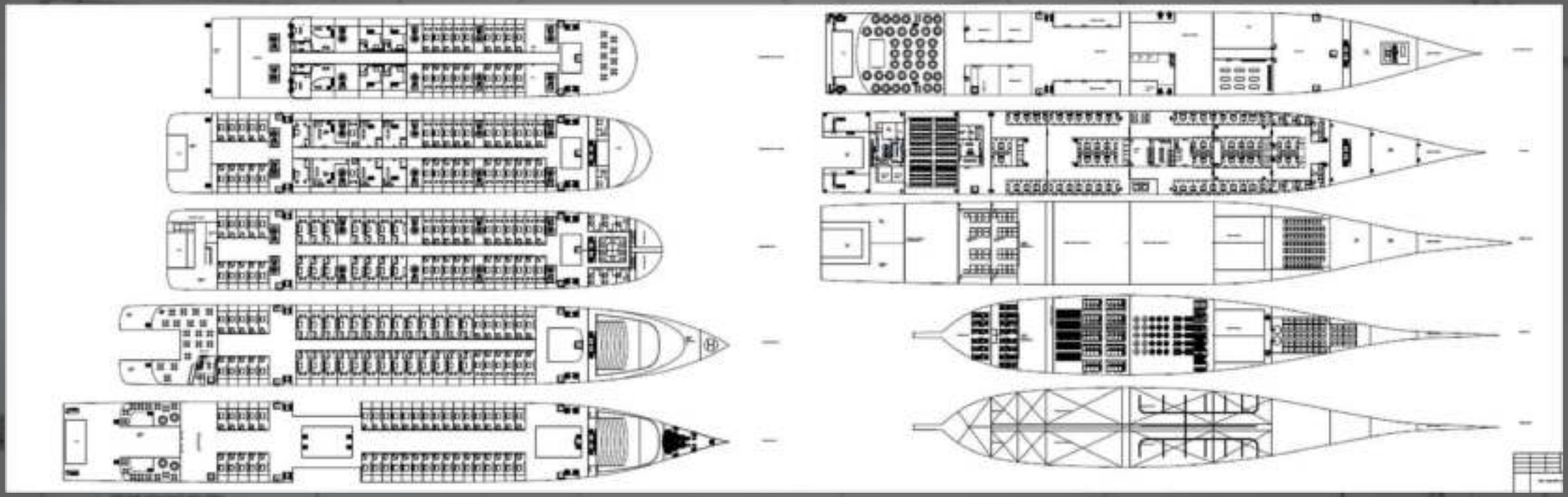
Sizing and hull



1 Development of the project

General arrangement

- With the hull designed, the structural elements are determined to define and verify the compartments at the beginning and end of the project and with it, the general layout.

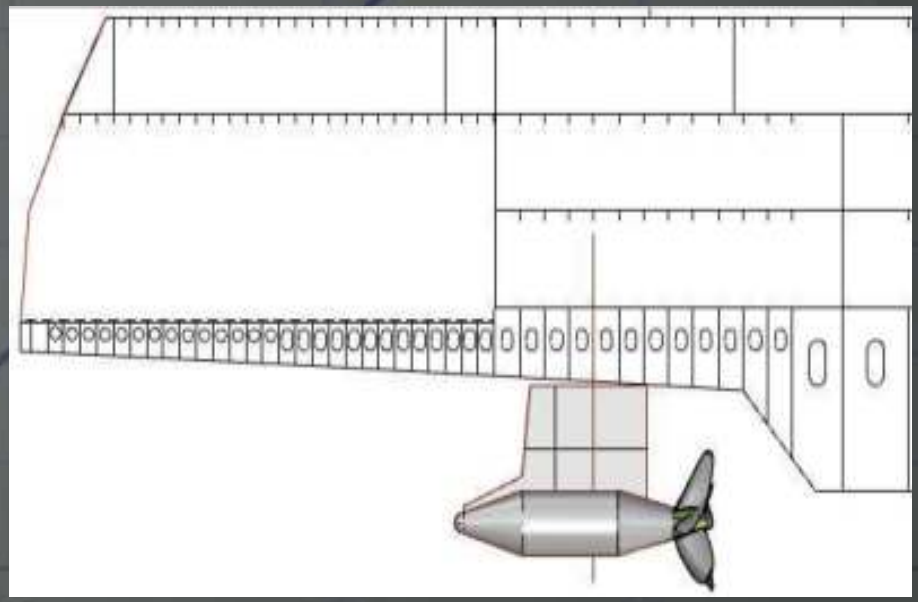


1 Development of the project

Propulsion

- With the results of the hull study, the propulsion is designed, which will be in two ways:

Electric propulsion

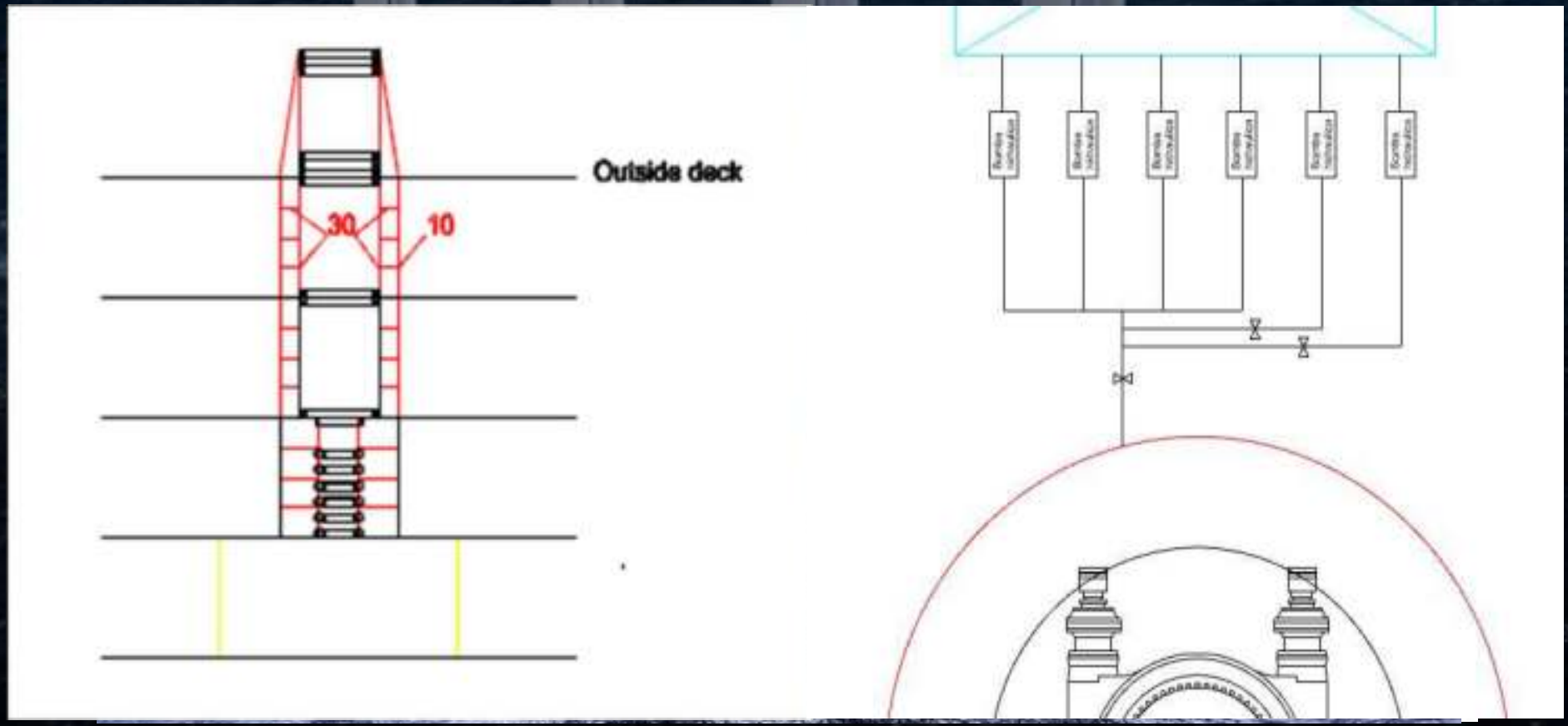


1 Development of the project

Propulsion

- With the results of the hull study, the propulsion is designed, which will be in two ways:

Sail propulsion



1 Development of the project

Ship systems

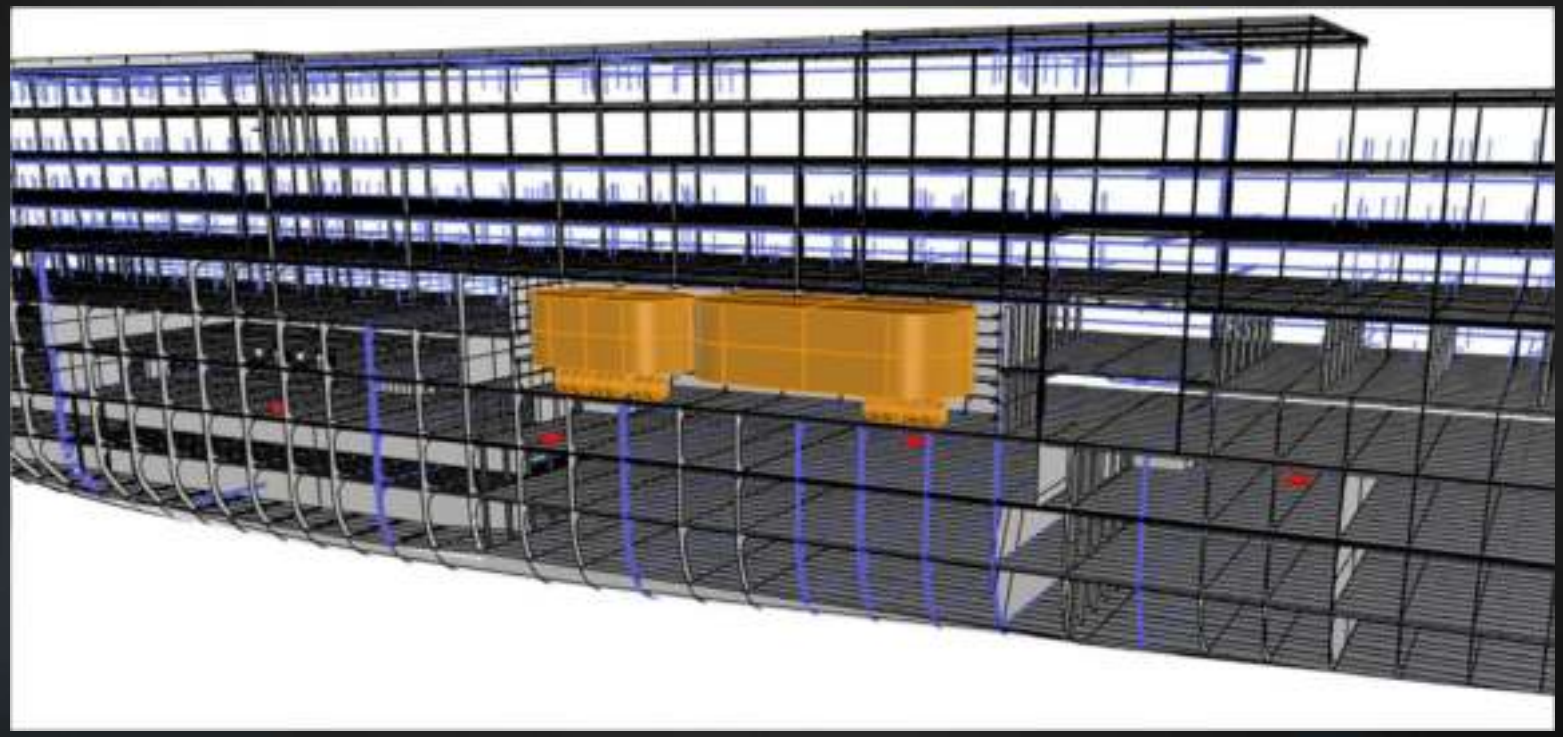
- Based on the needs of the passengers and the crew, the ship systems will be defined.

  - Solid waste disposal.
  - Sewage
  - Elevators
  - Laundry
  - Kitchens & Dining Rooms
  - Cleaning Services
  - Ventilation systems
  - Stabilizers
  - Bilge
  - Freshwater systems
  - Fire Fighting Systems
  - Lighting systems
  - Anchoring systems
  - Means of evacuation
  - Navigation systems

1 Development of the project

Ship systems

- Each of these systems has been designed in conjunction with the digital twin.



2 Alternative sources of energy

- With all known systems, the maximum possible consumption is estimated through an energy balance that will serve as the basis for the selection of the various alternative plants.

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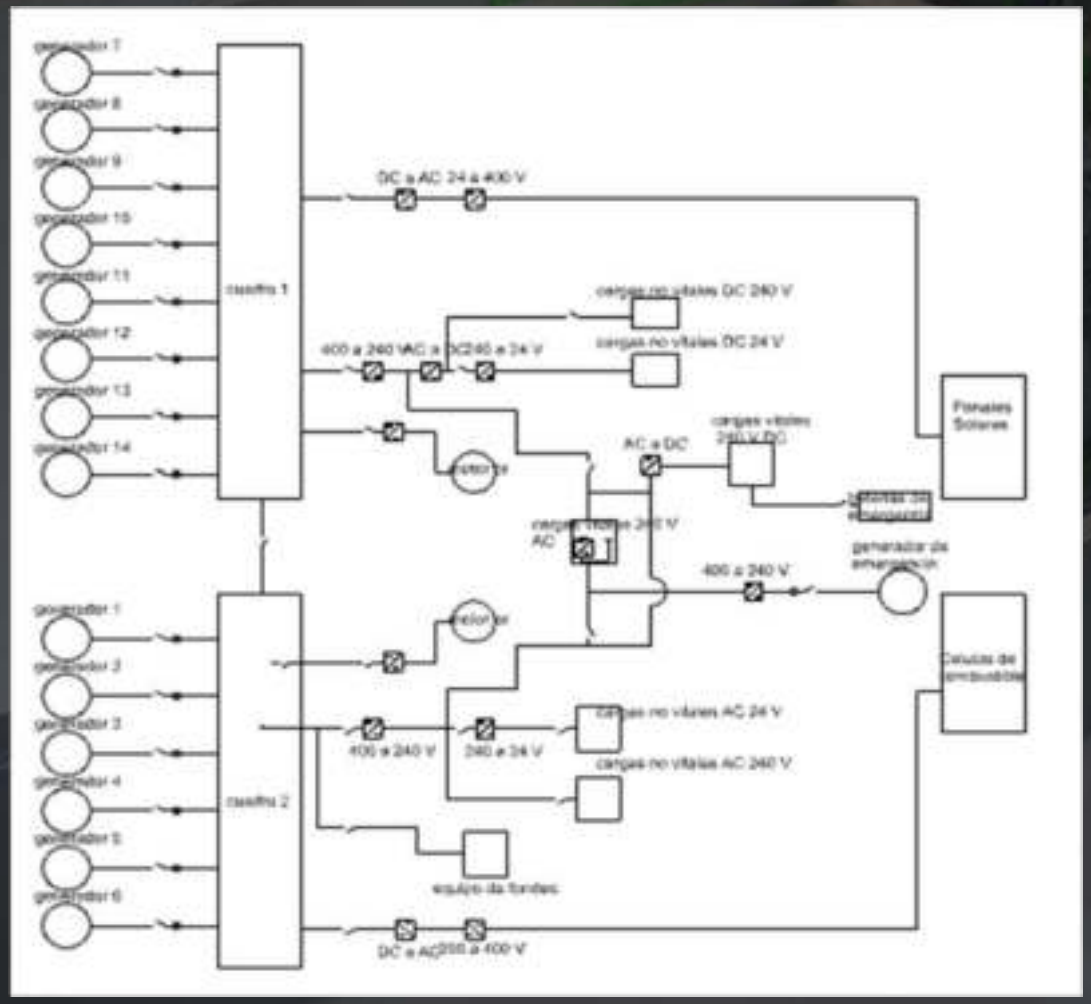
2 Alternative sources of energy

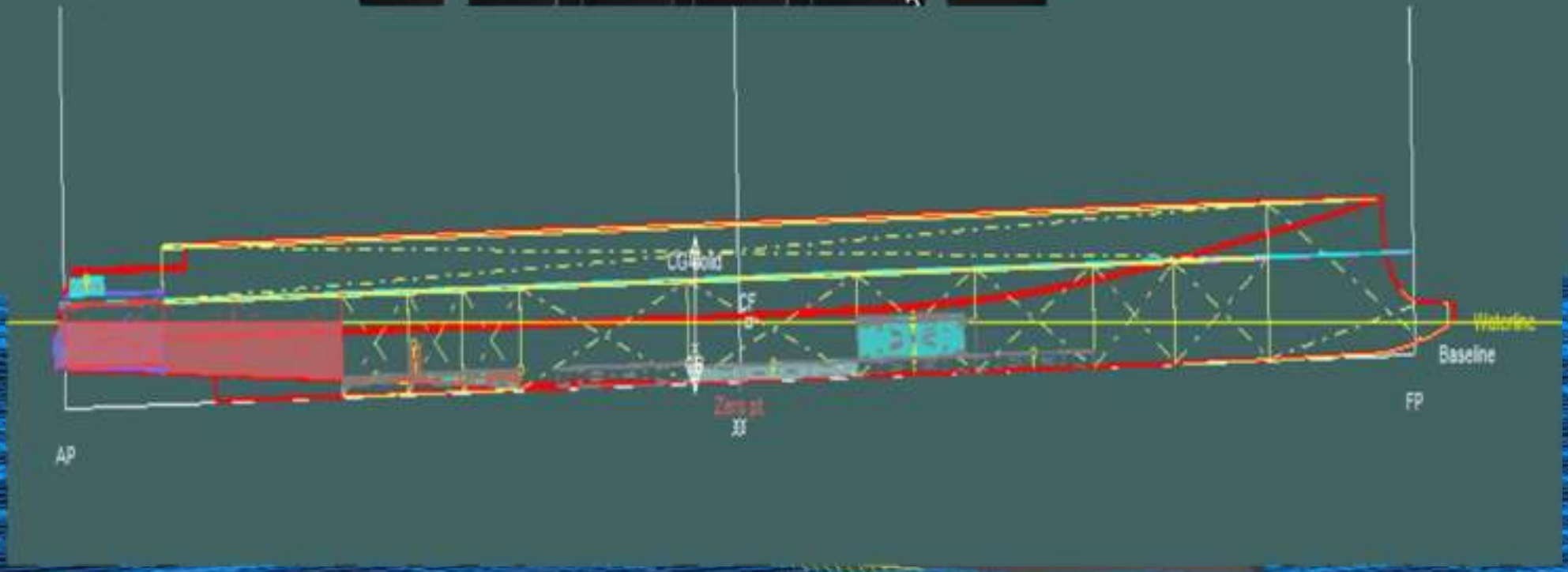
- With all these sources, there is a redundant electrical system.



3 Operating results

Stability and seakeeping

- Once the design of all the elements is known, the displacement is balanced and the stability under different conditions is evaluated.



3 Operating results

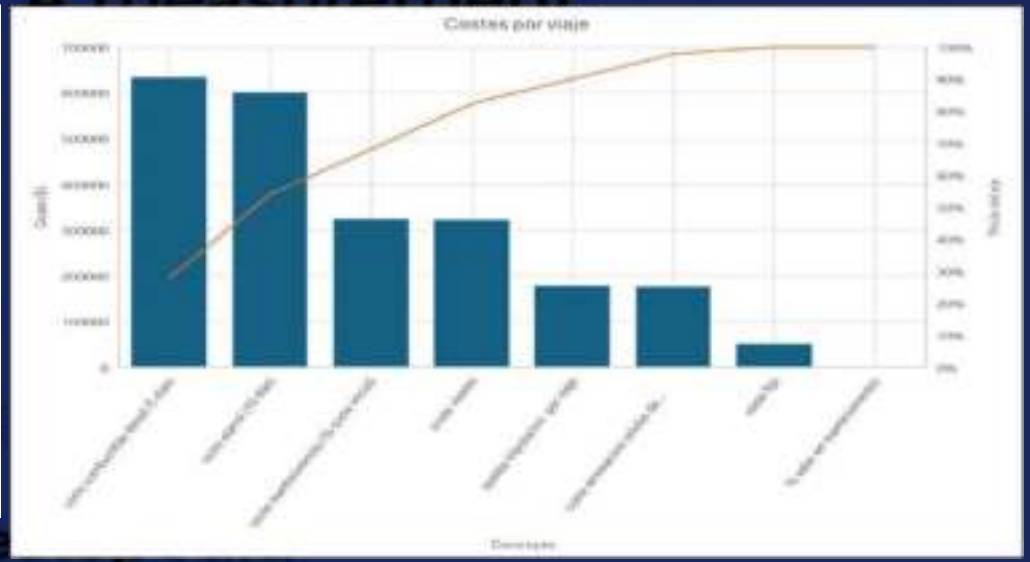
Operating costs

- The construction cost is closed by grouping it into the following concepts:
  - Materials Systems
  - Company Profit
  - Works

Concepto	Valor	Unidad
total material	87,5118267	millones de dolares
total sistemas	287,830856	millones de dolares
total obras	21,431379	millones de dolares
total	396,774062	millones de dolares
presupuesto	529,032082	millones de dolares

- The operational costs are grouped for a 7-day trip into:

coste remodelado	10	millones cada 10 años
Coste fijo	51023,58068	dólares por viaje
sueldo tripulación por viaje	178969,863	dólares por viaje
coste combustible diésel (5 días)	634438,0435	dólares por viaje
coste etanol (10 días)	600934,7022	dólares por viaje
coste mantenimiento (80 % coste inicial)	324666,2642	dólares por viaje
coste renovación células de combustible	176198,6301	dólares por viaje
coste víveres	322961,2404	dólares por viaje
coste total	1966311,084	dólares por viaje
tasa	173,9130435	dólares
Precio mínimo del billete	8366,875892	dólares



3 Operating results

Reduced costs and increased autonomy

- The costs of the previous chapter can be reduced from the sailing system by taking into account fluctuations in wind speed.

Highest wind speed

Velocidad (kn)	18	20	22	24
Ahorro energético planta propulsora (%)	76,46	52,05	39,36	26,66
Demanda eléctrica total (MW)	7,835	14,759	20,587	26,66

Combustible	Consumo diario (T/día)	Coste diario ($/día)	Coste sin vela ($/día)	Ahorro ($/día)	Ahorro (%)
Metanol	46,287	20829	55286	34457	62,32
Diesel	27,287	43980	116736	72756	62,32

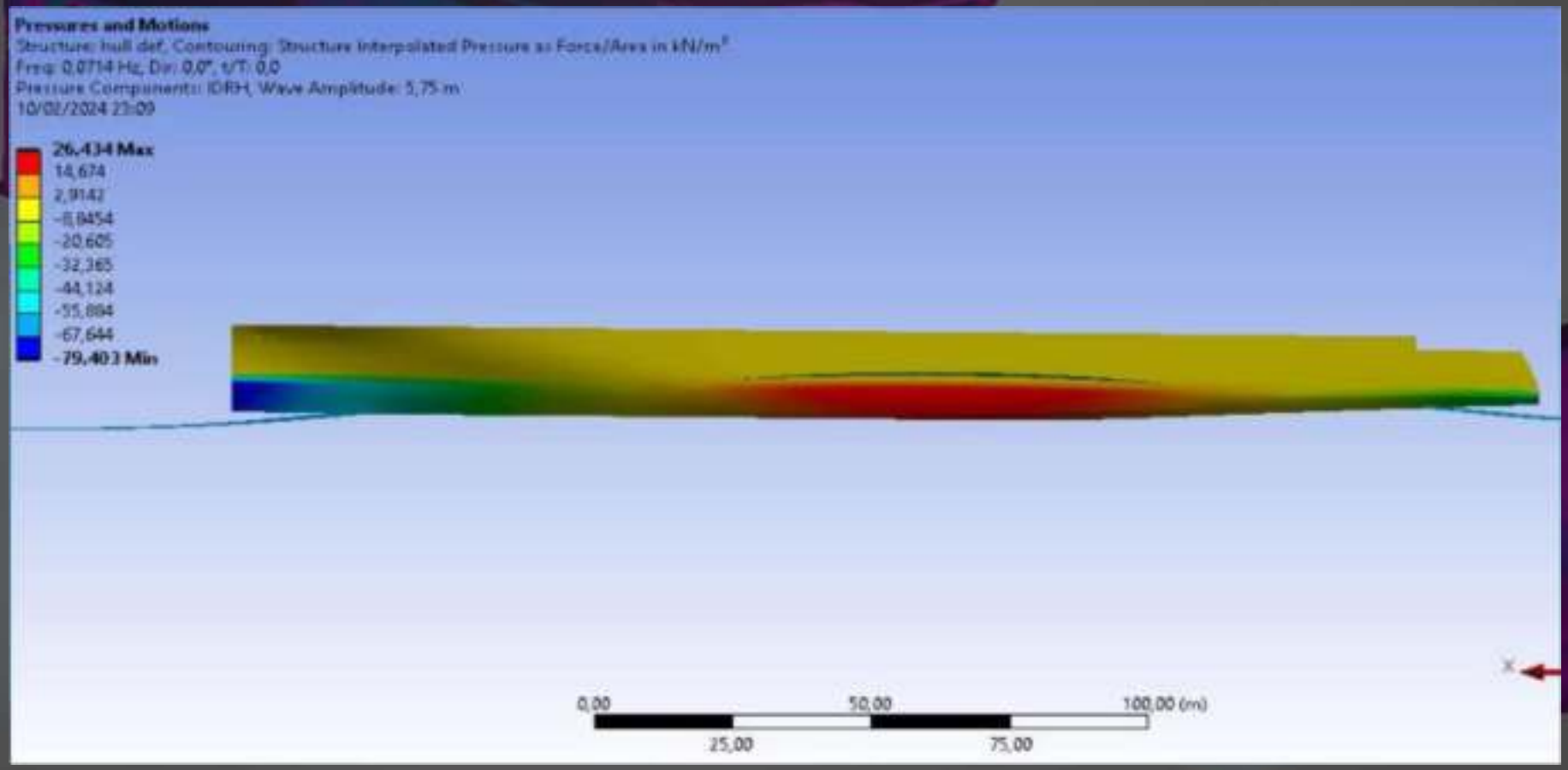
Lowest wind speed

Velocidad (kn)	18	20	22	24
Ahorro energético planta propulsora (%)	27,76	20,30	16,03	12,86
Demanda eléctrica total (MW)	8,78	13,24	17,67	22,84

Combustible	Consumo diario (T/día)	Coste diario ($/día)	Coste sin vela ($/día)	Ahorro ($/día)	Ahorro (%)
Metanol	104,232	46904	55286	8382	14,9
Diesel	61,447	99039	116736	17697	14,9

4 Simulation in development

- During the development of this project, the classic calculations by regulation have been complemented with the results of simulations to obtain the minimum values.



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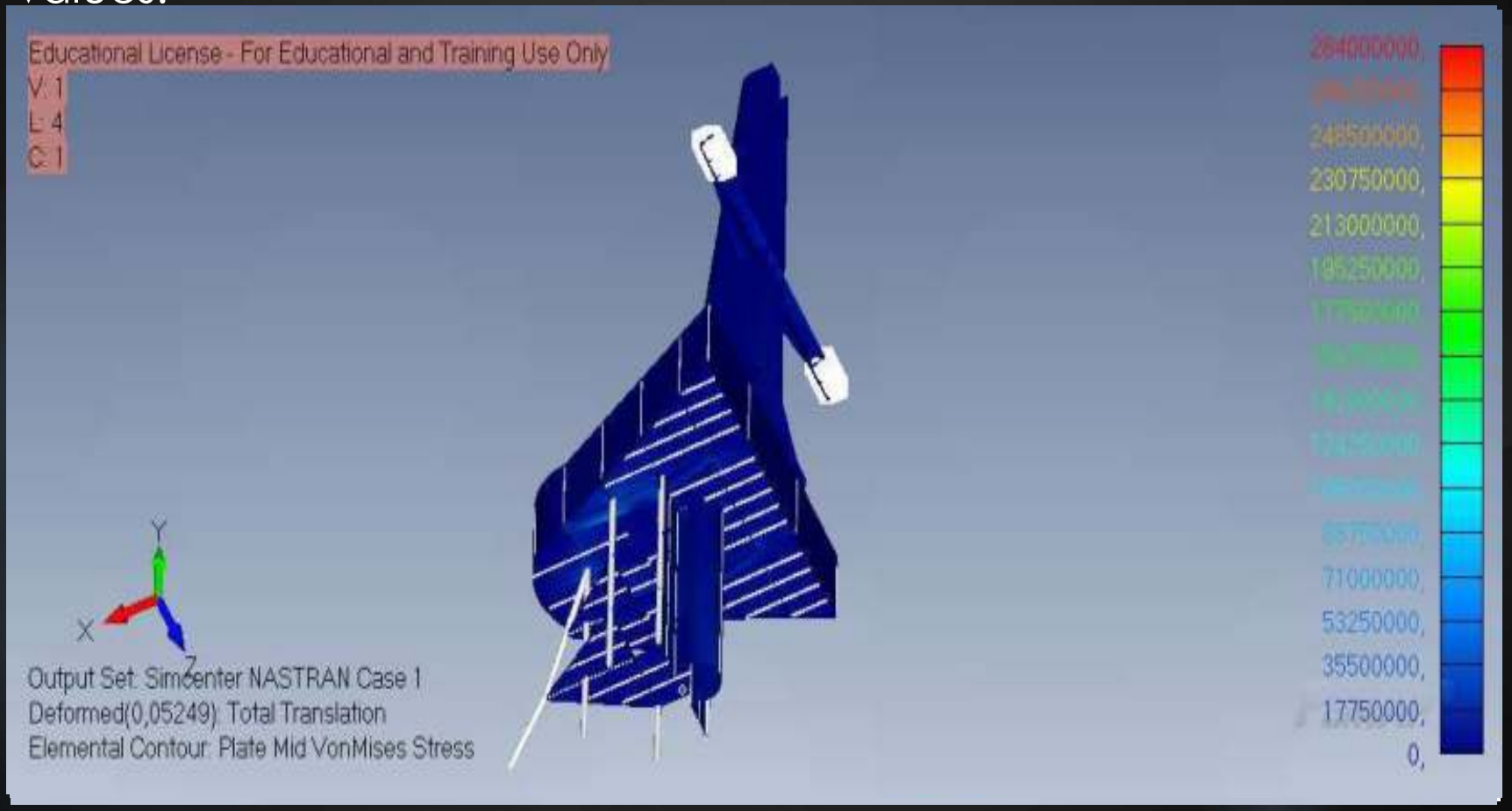

5 Digital Twin

- The development of this project has been accompanied by the creation of a digital twin.

6 Virtual Reality

- We move from the technical field to the commercial exhibition field.

6 Virtual Reality

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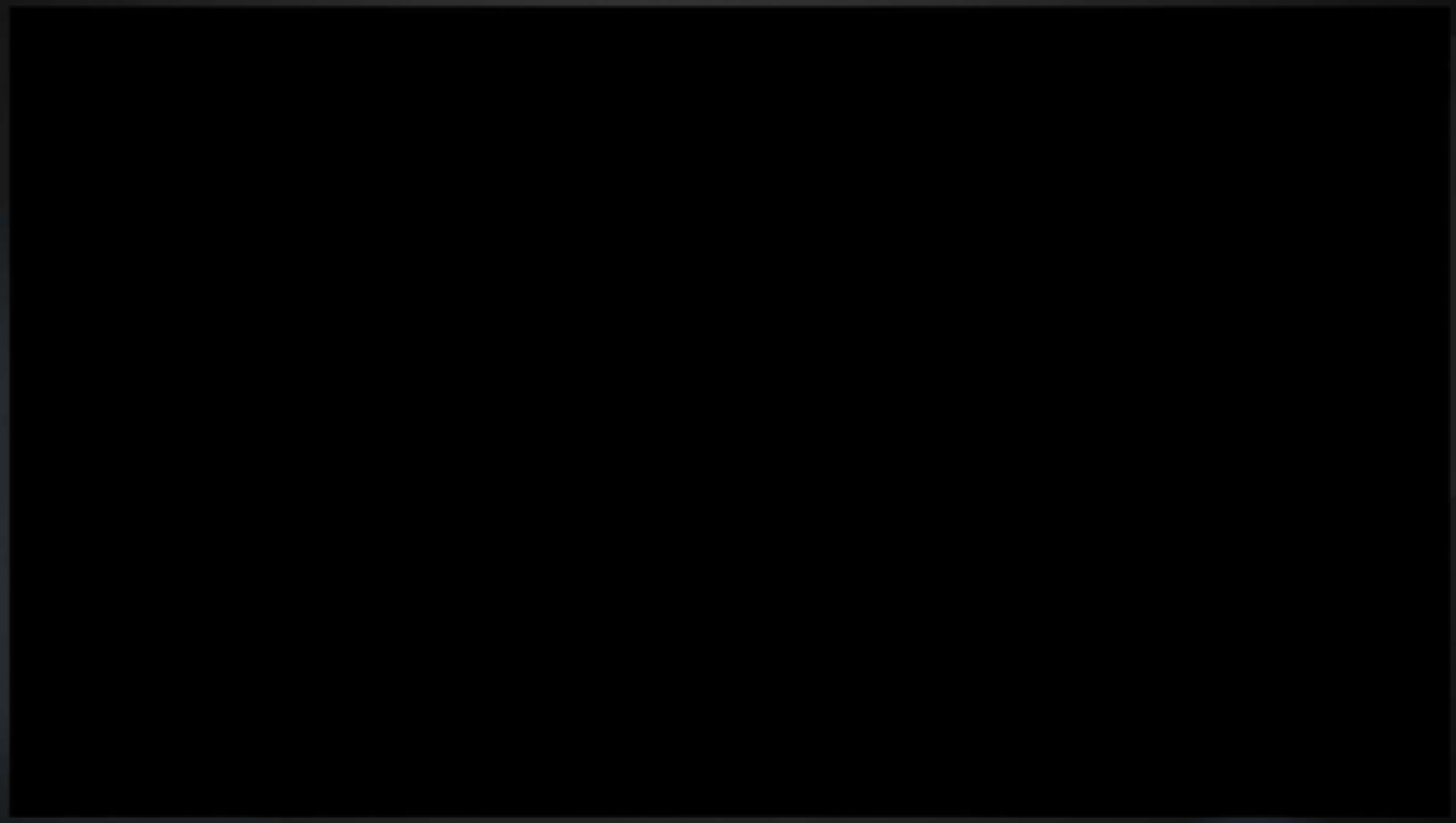

Thank you for your attention