



PREDICTIVE SIMULATION OF ONSHORE POWER SUPPLY REQUIREMENTS FOR PORTS

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Features



+25 years



**2.000
projects**



62 countries



30 people



PYME INNOVADORA
Válido hasta el 06 de noviembre de 2027



Maritime Simulation Center - Maritime Training Provider - DNV



2.000 seafarers



**800 training
programmes**



**60 international
shipping companies**





OPS

- ▶ Cold ironing / shore-to-ship power
- ▶ Regulations
 - ▶ IMO
 - ▶ EU directives
 - ▶ National environmental standards
- ▶ Benefits
 - ▶ Renewable energy
 - ▶ Reduction:
 - ▶ Emissions (Nox, Sox, CO₂, COV)
 - ▶ Noise and vibrations
 - ▶ Wear and tear on engines
 - ▶ Fuel consumption
- ▶ Barriers
 - ▶ High investment
 - ▶ Vessel (specific equipment) and port infrastructure (substations)
 - ▶ Personnel

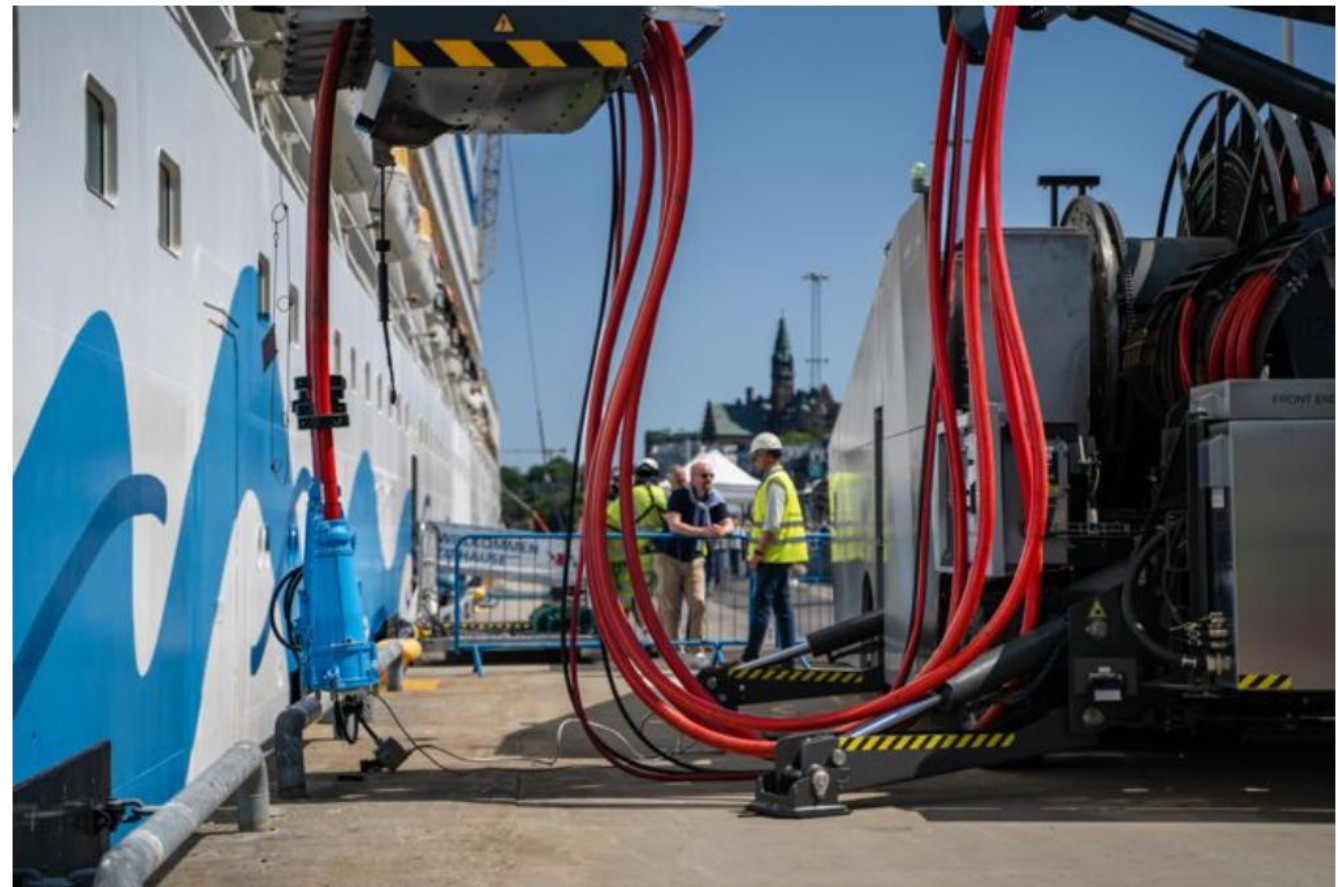
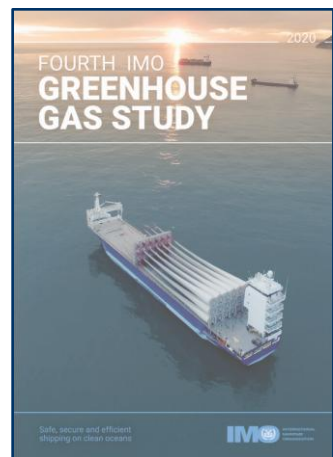
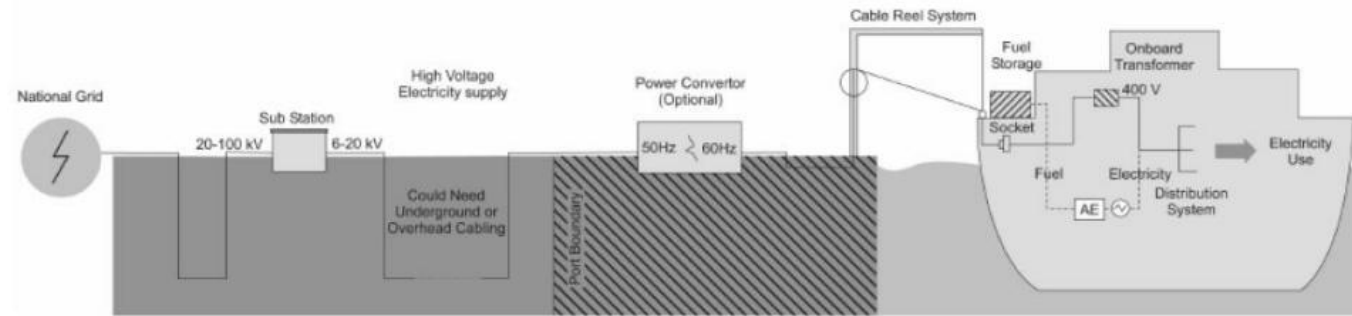


Illustration. Courtesy of Ports of Stockholm





Key points



► Purpose:

- Methodology for sizing and optimization of OPS facilities.
- Provide decision-makers with a data-driven support tool for OPS planning.

► Key Functions

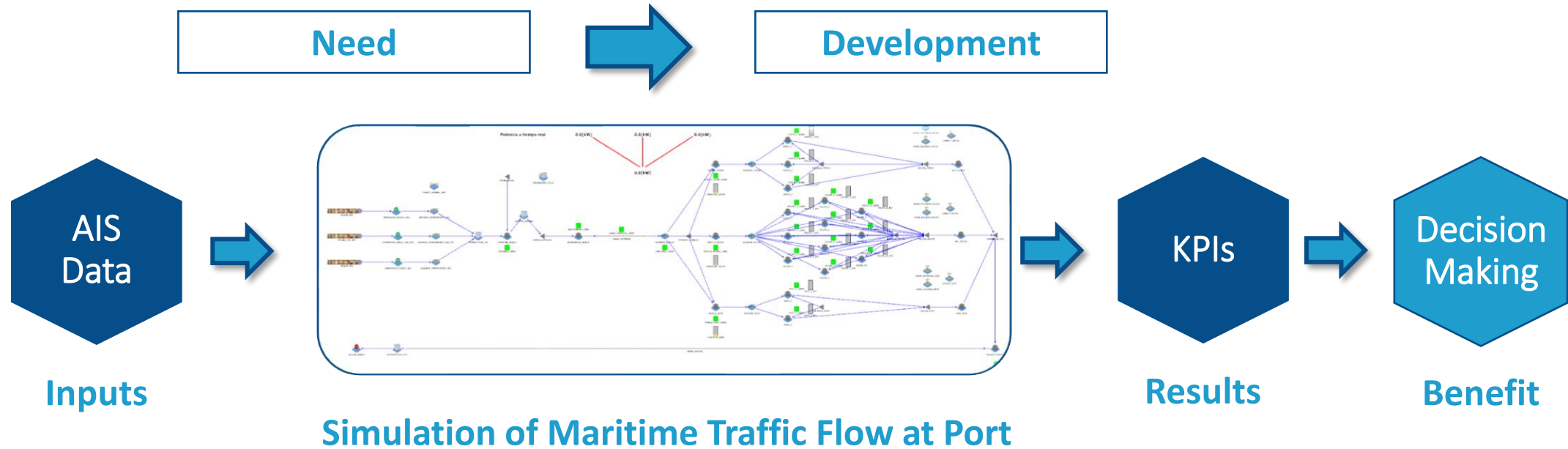
- Optimize the dimensioning of substations and power supply networks.
- Identify and estimate energy needs based on:
 - Type of maritime traffic (e.g. container, cruise, ro-ro).
 - Volume of vessel calls per terminal.
 - Combined demand from all port terminals.

► Benefits:

- Supports efficient infrastructure investment and deployment.
- Enables phased and prioritized implementation aligned with real demand.
- Enhances overall port energy planning and sustainability strategy.



Methodology



Work Methodology for the Cost / Benefit Assessment

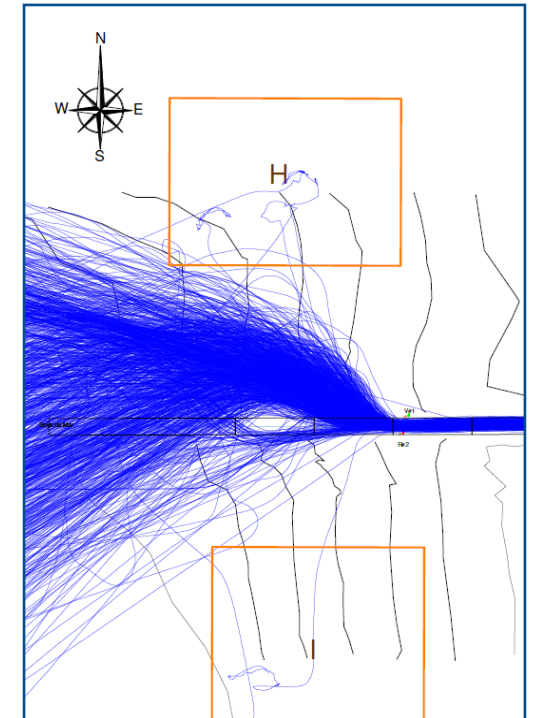
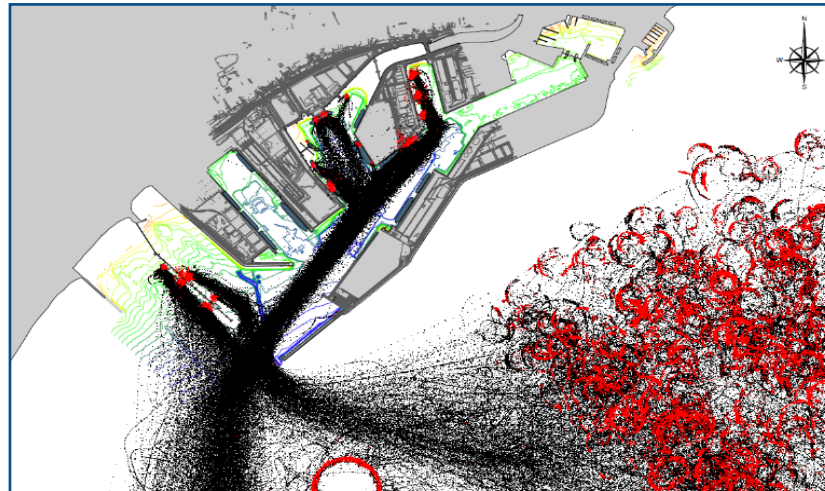
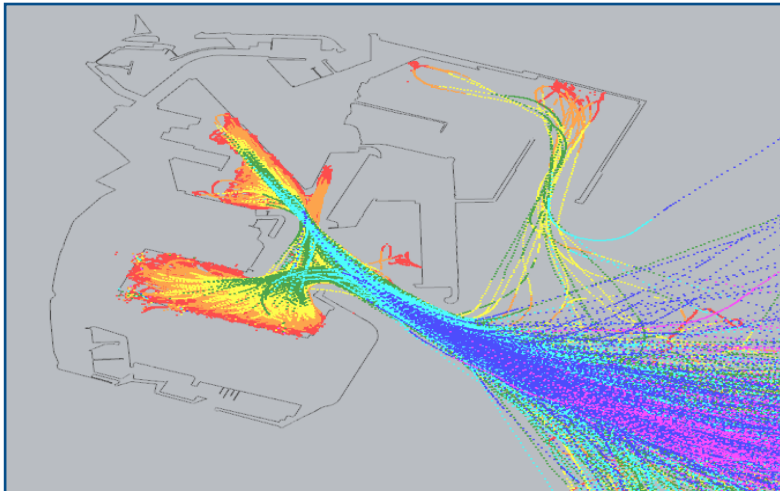
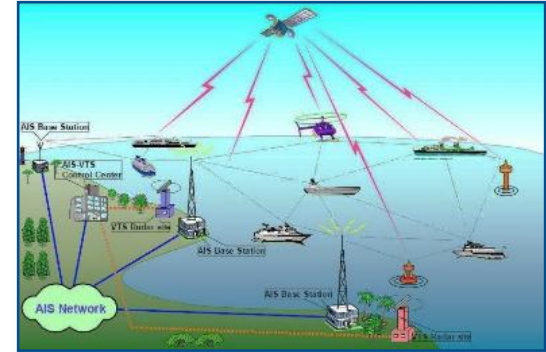


AIS Data Analysis

AIS
Data

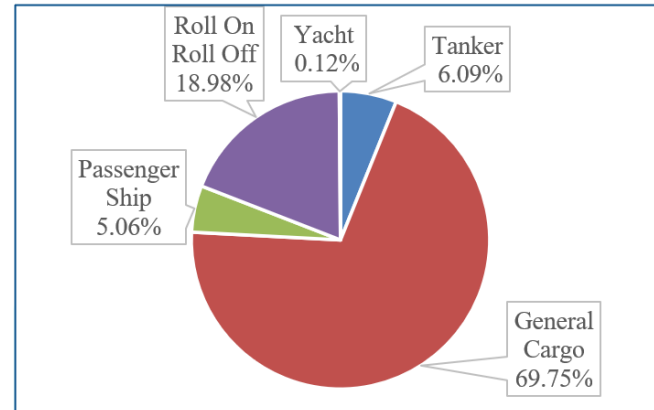
- ▶ Large Data Volume
- ▶ Big Data, DataAnalytics & DataViz techniques
- ▶ AI
- ▶ Detailed Quantitative Description of the Traffic Flow

- Vessel Types, Size Distributions and Draught
- Routes & Speed, Seasonality
- Berth Stays (Number & Time)

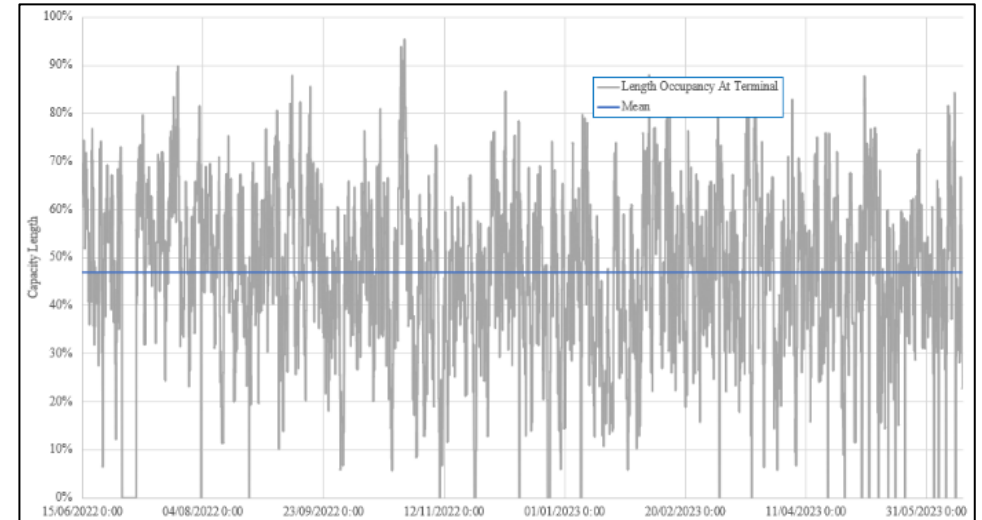




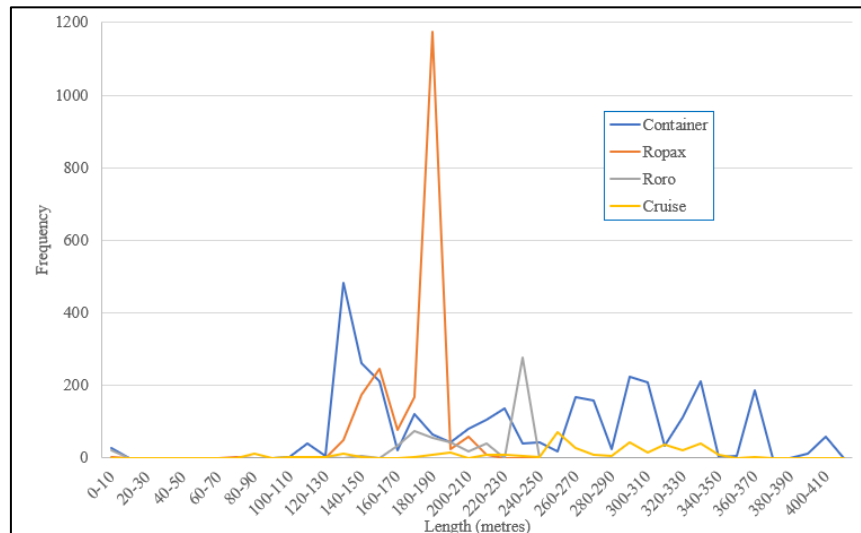
AIS Data Analysis



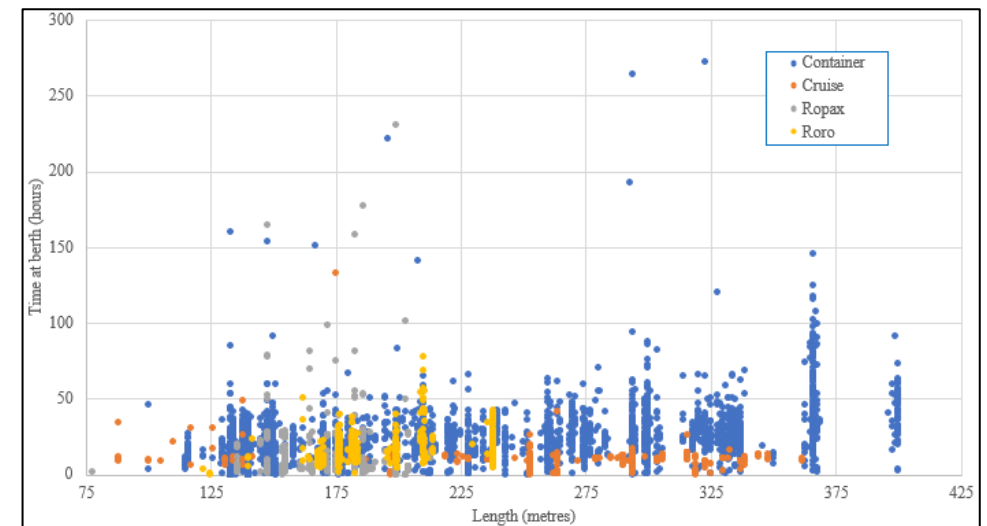
Occupancy level of berth length



Vesel Size / type



Time at berth

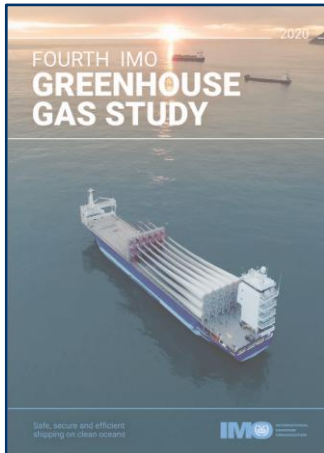




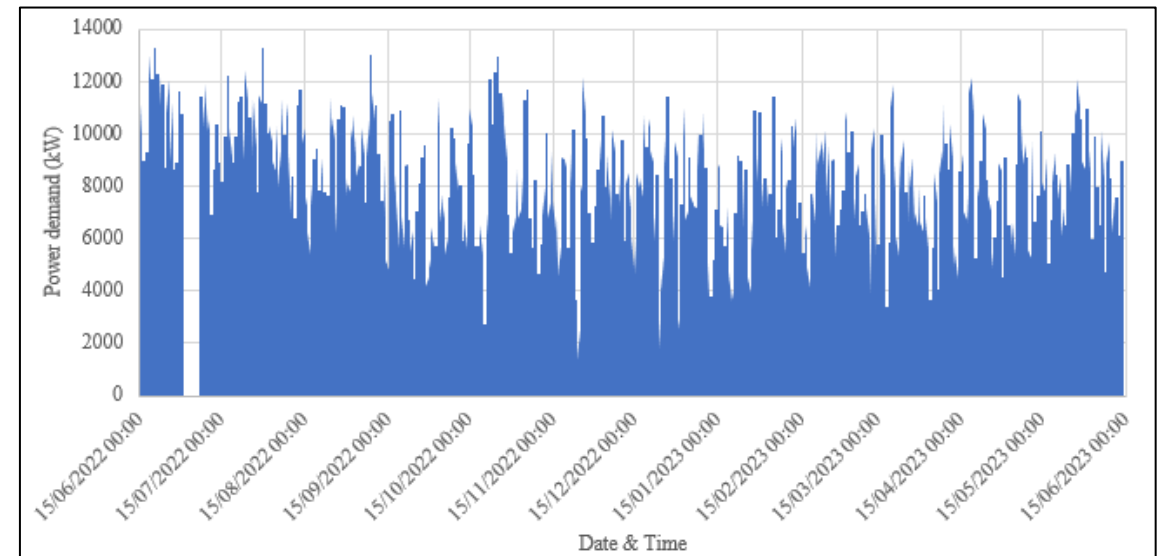
Auxiliary Engine Power Demand



- ▶ At berth
- ▶ Auxiliary engines
- ▶ Ref. The Fourth IMO Greenhouse Gas Study



Power demand by container ship





KPIs Definition

KPIs

- ▶ Key Performance Indicators ad-hoc for each Project
- ▶ Aligned with Individual Projects Aims & Particularities
- ▶ Parameters for Calibration (Base Model) & Evaluation (Alternative Scenarios)



Efficiency

- Terminals Occupancy Level
- Service Time (Loading / Unloading)
- Waiting Time & Causes (Bottlenecks)



Power Demand

- Substations Requirements (Trends, Average, Peaks, etc.)
- Percentage to Cover (Regulations)



Financial

- Electricity Fees
- Required System Sources (Operators, Cranes, etc.)



Environmental

- Carbon Footprint Reduction
- Elimination of Noise and Vibrations

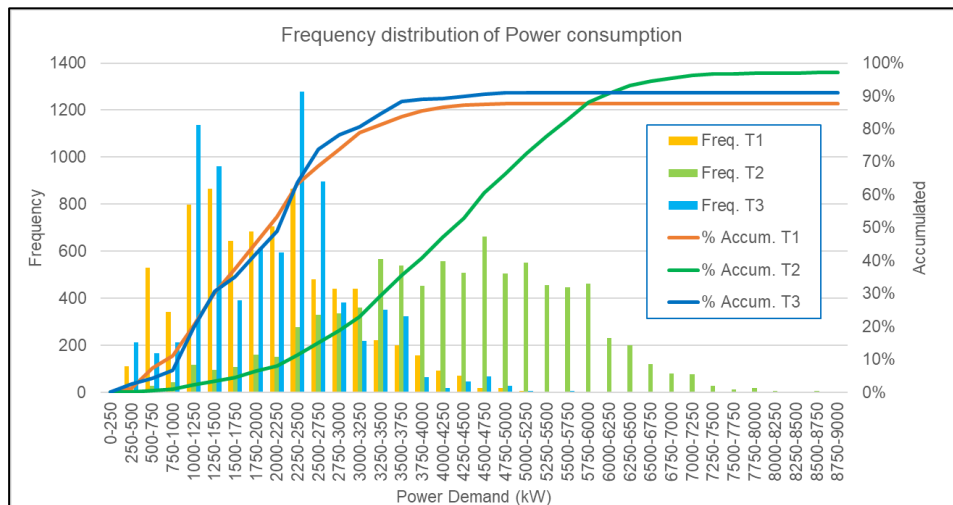


KPIs Definition

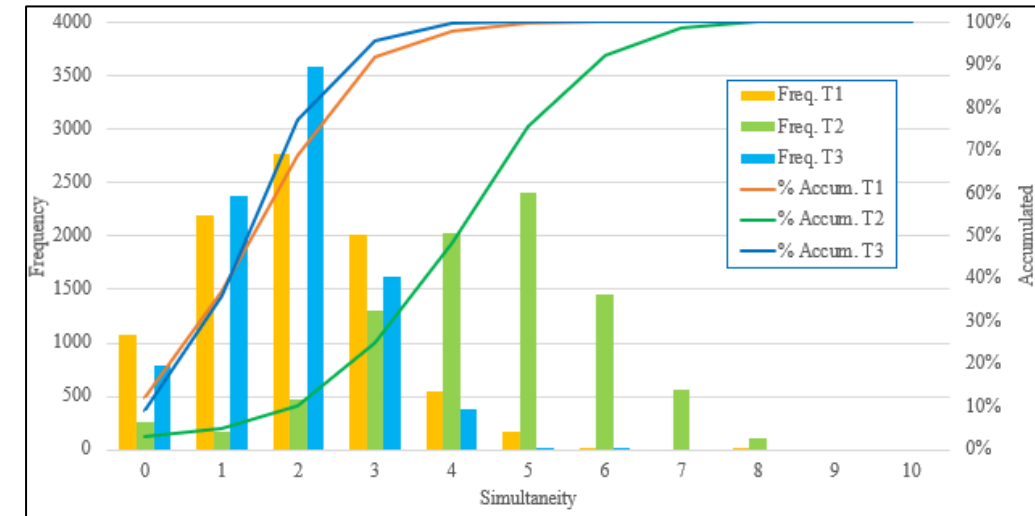
KPIs

- Use of the terminals related to the efficiency of the ports

Power demand



Simultaneity of vessel

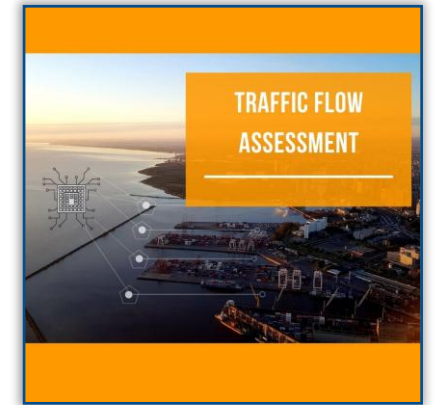




Model Building



- ▶ **SiOPS21: Simulation of Port Traffic & OPS Connection**
- ▶ Probabilistic distribution based on AIS data -> random data close to reality
- ▶ Discrete Event Simulator

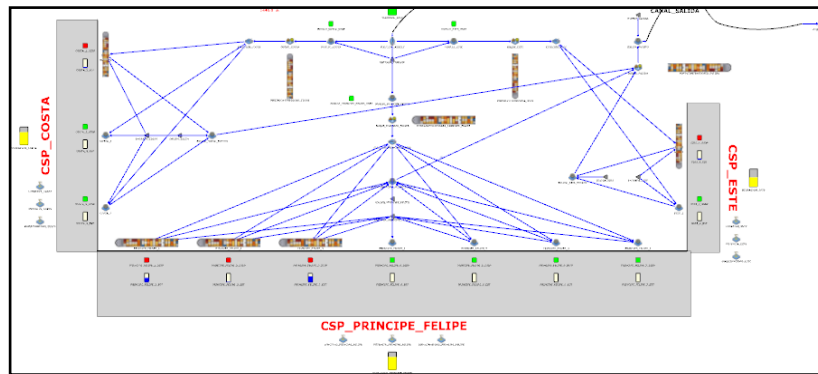
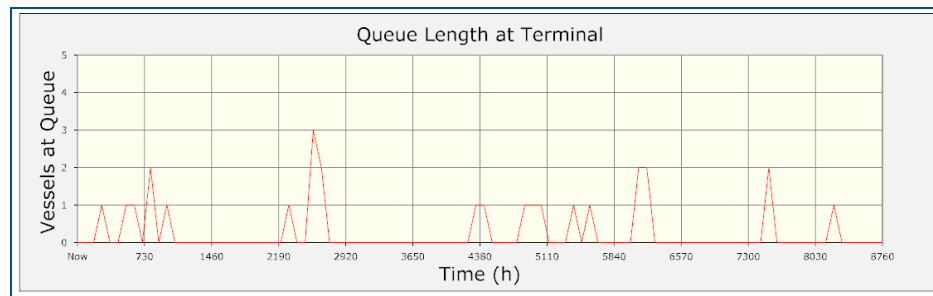
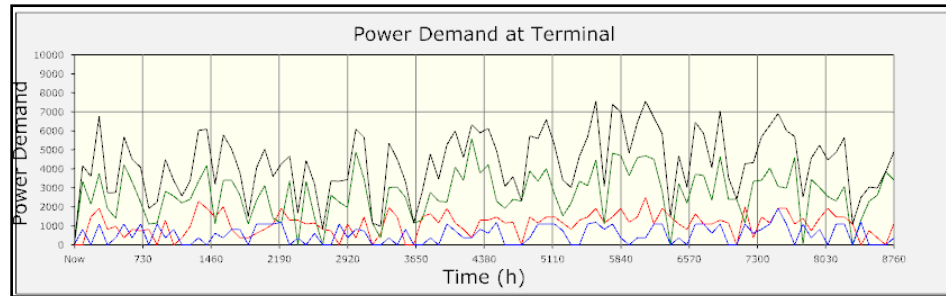


- ▶ Sequential Process
- ▶ Joint Decision-Making: Rules, Infrastructure, ...
- ▶ Analyze Period: One Year (Seasonality), Several Random Repetitions (Statistical Analysis)

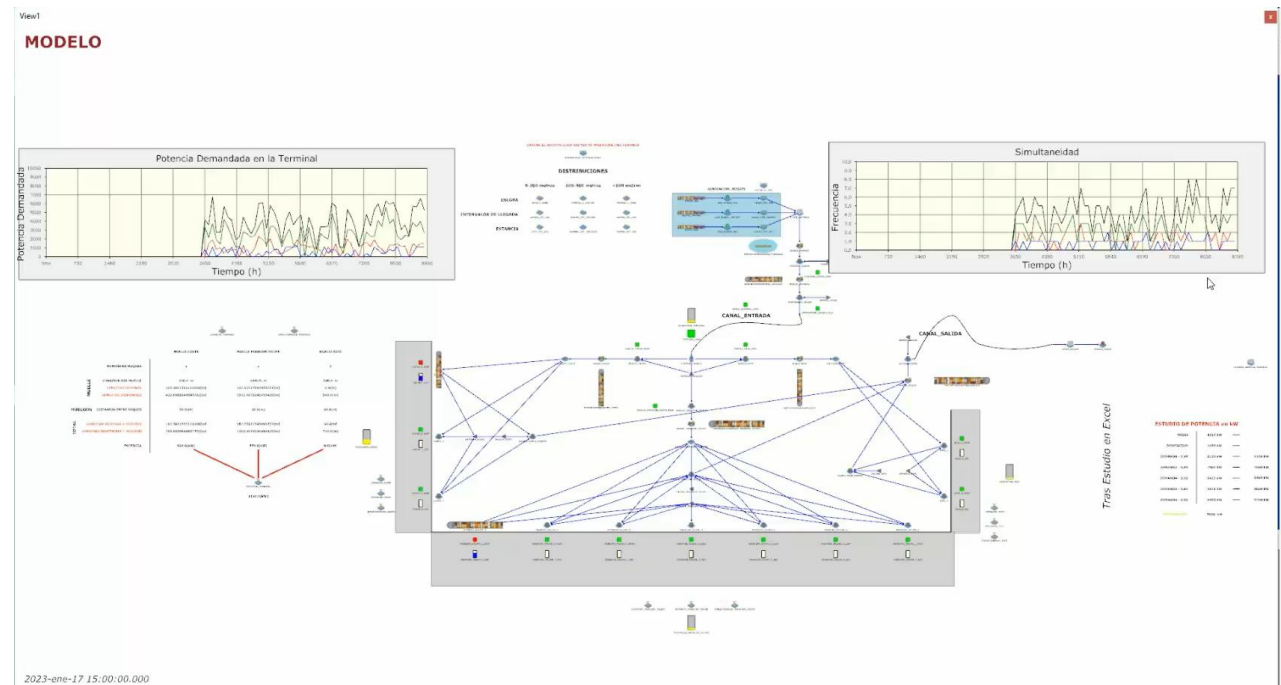
Vessels (Dynamic)	•SIZE: Length, Beam, Draught •ROUTE: Destination, Time at Berth •SEASONALITY	COMPONENTS
Port Elements (Static)	•BERTHS: Number of Berths, Berthing Length •CAPACITY: Length, Simultaneity, Power Demand	
Other Conditions	•ENVIROMENTAL: Wind, Tide, Waves •REGULATIONS: Carbon Footprint, OPS	



Model Building



- Discrete Event Simulation Software
- Input & Output Processing - Performance Analysis
- Planning & Decision-Making





Model Calibration

SiOPS21

Calibration
Simulations

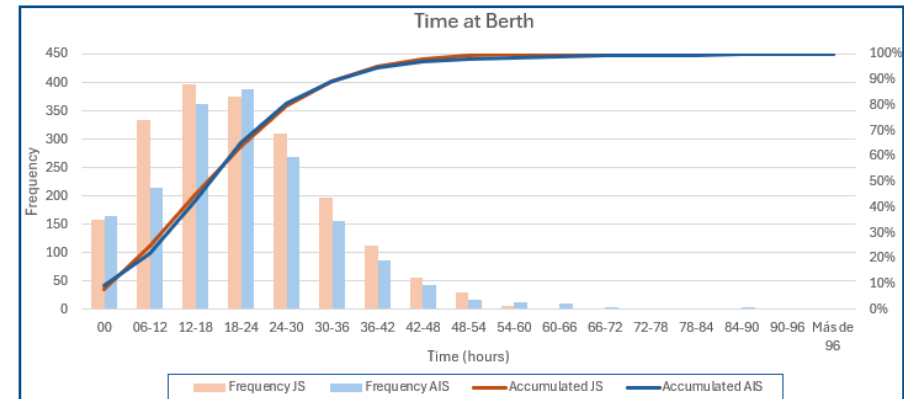
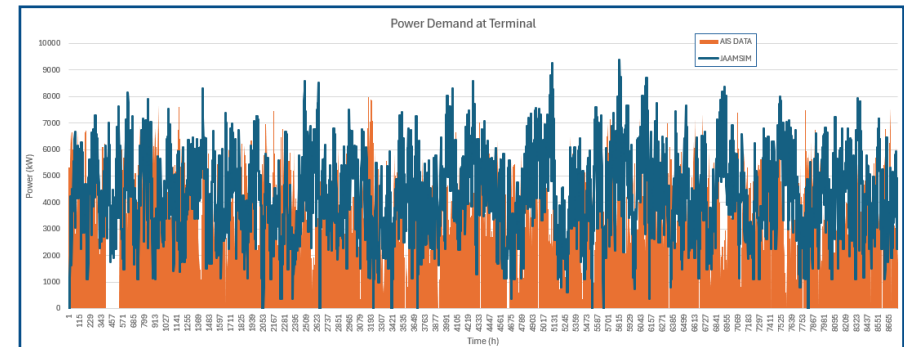
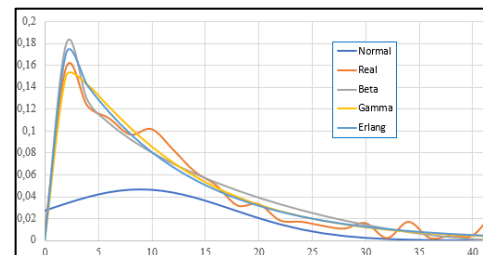
- Current Situation
- Inputs from Analyzed Info (AIS data)
- Other Aspects to Consider

Fine-Tuning

- Model Parameters
- Level of Detail
- Additional Inputs

Comparison
(KPIs)

- Model Results vs. Reality (AIS Data)
- Acceptable Deviations





Alternative Scenarios

SiOPS21

- ▶ Alternative Scenarios Definition
- ▶ Potential Impact on Current Traffic Flow

**KPIs Justified
Decision-Making**

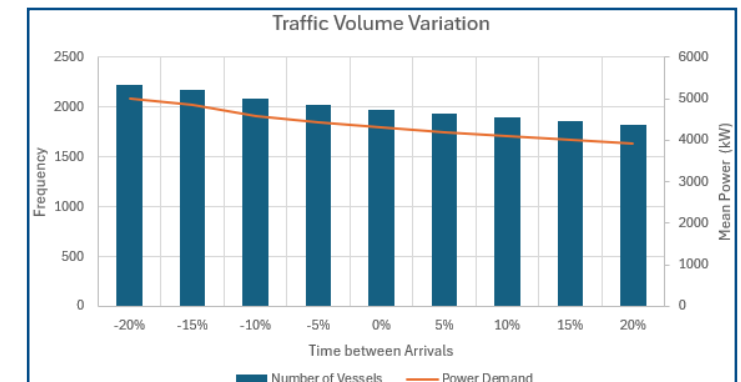
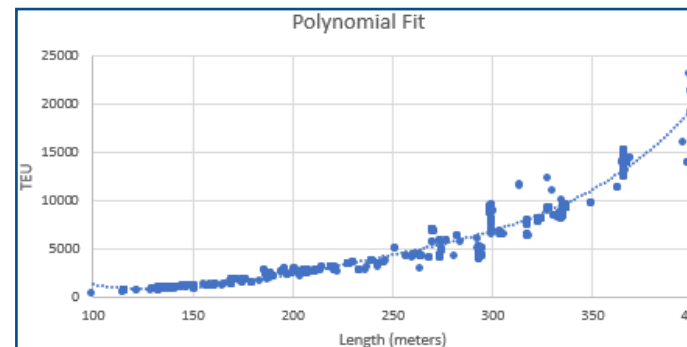
VERSATILITY

- New Infrastructures
- Traffic Volume Increase

LIFESPAN

- Traffic Forecast
- Historical Data
- Masterplans

CURRENT + FUTURE (OPTIMISTIC + PESIMISTIC)





Conclusions

- ▶ Methodology for sizing and optimization of OPS facilities.
- ▶ Electricity grid dimensioning tool
- ▶ Support for green energy production infrastructures
- ▶ Advanced tool for berthing management
- ▶ Utilization for risk-efficiency optimum balance
- ▶ Smart ports working methodologies





A different view of the engineering
SIPORT21@SIPORT21.ES

