

1. GENERAL INFORMATION

A. Case study title

Best practice - Port of Constanta (Romania)

Note: This case study is a combined research project performed in two steps: first, field research on the site of one towing company at Constanta port, collecting actual and factual data on the spot, and second, extensive desk research for additional data collection, verification and analysis to complete and conclude the study.

B. Green practice implemented

Practice 10: Minimization of engine running time

C. Specific goals

This case study showcases the benefits of adopting green practices in port operations by estimating fuel consumption and related CO2 emissions for a fleet of 14 tugboats, comparing figures of consumption/CO2 emissions/costs before (as a scenario) and after implementation of the green practice, i.e. minimisation of engine running time.

D. Direct impact of the practice

- Emissions reduction
- Reduction of operational costs
- Alignment with green port practices and policies for reducing the port's carbon footprint

E. Place of implementation

Port of Constanta (Romania)

F. Start and end date or duration of the pilot project

It is already an implemented practice for the tugboat companies accredited for towage & mooring operations at the port of Constanta (see below description).

2. CONTEXT AND DESCRIPTION

A. Description of the practice

The tugboats implement the practice while they are idle (moored). Three tugboat companies at the port of Constanta are currently accredited for operations (mooring/unmooring and port towage). Each company operates in sequence, ten days per month; that means 20 days per month tugs are mostly idle; therefore, switching to shore power supply comes with many benefits besides alignment with the green port policies.

B. Driving factor behind the adoption of the green practice

Port of Constanța has implemented several green initiatives aimed at enhancing environmental sustainability and reducing its carbon footprint:

- **Green Port Master Plan Development:** In March 2024, the Port of Constanța organized a workshop to analyse and revise its Green Port Master Plan. This plan is a dynamic roadmap guiding the port towards carbon neutrality and sustainable development.
- **Participation in the PIONEERS Project:** The Port of Constanța participates in the PIONEERS (PORTable Innovation Open Network for Efficiency and Emissions Reduction Solutions) project to optimize port operations and implement renewable energy and mobility solutions.
- **Electrification of port infrastructure:** In July 2024, a global logistics company specializing in port operations secured a €50 million loan from the European Bank for Reconstruction and Development to finance the electrification of the Constanța South Container Terminal. This project includes installing new electrical networks, transformer points, electric vehicles, charging stations, and new railway lines to reduce the terminal's carbon footprint and enhance energy efficiency.

However, on-site research concluded that the tugboat companies implemented the practice primarily because of economic benefits rather than alignment with green port policy. Section 5 below will show the financial and environmental benefits.

c. Stakeholders involved

- Port Administration
- Towing companies
- Tugboats crew

The Port Administration is interested in reducing the carbon footprint and is encouraging such practices. Towage companies have primarily financial interests (see sections 4 and 5 below). Tugboats are directly involved, obviously, with the crew connecting/disconnecting the shore power supply.

3. IMPLEMENTATION

A. Description of the adopted practice

See the description in section 2/A above.

B. Technologies used (if applicable)

Not applicable

c. Competencies required

No specific competencies are needed. Connection/disconnection is a simple operation made quickly and safely by a single crew member with adequate training. However, it has been noted that personnel (crew) did show much environmental awareness when questioned about the benefits of switching on the shore power supply. They were satisfied with the comfort gained, no noise and not much equipment running (running hours). This point might be considered regarding environmental awareness and behavioural change education amongst involved personnel within the industry.

4. COLLECTED DATA

A. Before implementation

As the practice is already implemented, calculations, as shown in the tables below, are made as a scenario by estimating total fuel consumption for a fleet of 14 tugs belonging to one of the towage companies at Constanta Port.

Only one type of fuel is used, marine Diesel Oil; for calculation purposes, an average density of 0.86 kg/m³ and an emission factor of 3.2 kg CO₂ per kg of fuel was taken. This approach is widely used in similar studies or research projects.

For calculation purposes:

- The 4 hours/day of manoeuvring time for each tug was calculated based on the average of 20 ship movements (arrival/departure/shifting) per day for the past few months, as a senior pilot at Constanta Pilot Service Office stated. Split over the total fleet of 14 tugs, considering 1.5 tugs used for each manoeuvre, that would give an approximate 2 hours of manoeuvring time, plus another 2 hours proceeding/returning to ship/return to base, going to 4 hrs total for calculation purposes.
- 24 hours of hotelling consumption—this also includes the time for manoeuvring, with hotel load not precisely the same as an idle condition but very close to it.

The table below shows a summary of fuel consumption calculations, for one day, for the whole fleet of 14 tugs:

Fuel consumption - before practice implementation					
Nr of tugs	Power (kw) range groups	Fuel cons 1 tug 24 hrs hotelling (mt)	ME fuel cons 4 hrs maneuver (mt)	Aggregate consumption for 1 tug (mt)/day	Total consumption per group of tugs (mt)/day
4	600-1200	0.24	0.15	0.39	1.56
4	1500-2000	0.41	0.27	0.68	2.72
2	2200-2600	0.60	0.41	1.01	2.02
4	3000-3500	0.75	0.51	1.26	5.04
Fleet total fuel consumption for 1 day					11.34
<i>Note: fuel consumption calculated based on data collected from chief engineers' interview onboard 4 sample tugs</i>					

B. After implementation:

The table below shows a summary of fuel consumption calculations, for one day, for the whole fleet of 14 tugs:

Fuel consumption - after practice implementation					
Nr of tugs	Power (kw) range groups	Fuel cons 1 tug 4 hrs hotelling (mt)	ME fuel cons 4 hrs maneuver (mt)	Aggregate consumption for 1 tug (mt)/day	Total consumption per group of tugs (mt)/day
4	600-1200	0.04	0.15	0.19	0.76
4	1500-2000	0.07	0.27	0.34	1.36
2	2200-2600	0.10	0.41	0.51	1.02
4	3000-3500	0.13	0.51	0.64	2.56
Fleet total fuel consumption for 1 day					5.70

5. ECONOMIC AND ENVIRONMENTAL ANALYSIS (IF THE INFORMATION IS ACCESSIBLE)

A. Initial investment required

No information.

B. Key savings or economic impact

Fuel costs - before practice implementation					
Nr of tugs	Power (kw) range groups	Aggregate fuel consumption for 1 tug (mt)/day	Estimated cost (euro) per 1 ton fuel (marine diesel oil)	Total cost (euro) for 1 tug / 1 day	Total cost (euro) per group of tugs / day
4	600-1200	0.39	700.00	273.00	1092.00
4	1500-2000	0.68	700.00	476.00	1904.00
2	2200-2600	1.01	700.00	707.00	1414.00
4	3000-3500	1.26	700.00	882.00	3528.00
Fleet total fuel cost for 1 day				7938.00	

Fuel costs - after practice implementation					
Nr of tugs	Power (kw) range groups	Aggregate consumption for 1 tug (mt)/day	Estimated cost (euro) per 1 ton fuel (marine diesel oil)	Total cost (euro) for 1 tug / 1 day	Total cost (euro) per group of tugs / day
4	600-1200	0.19	700.00	133.00	532.00
4	1500-2000	0.34	700.00	238.00	952.00
2	2200-2600	0.51	700.00	357.00	714.00
4	3000-3500	0.64	700.00	448.00	1792.00
Fleet total fuel cost (euro) for 1 day				3990.00	

Comparing fuel costs before and after green practice implementation, the whole fleet saved 3948 euros daily; the savings increased to over 100,000 euros monthly.

Certainly, there will be a cost for the shore power supply; however, it should be much less than the total fuel savings, besides the primary goal of emissions reduction. This cost was not chased during this research.

C. Contribution to environmental goals

Environmental goal: reduction of CO2 emissions.

For the calculation of CO2 emissions, the following formula was used:

$$\text{CO2 Emissions [kg]} = \text{Fuel Consumption [metric tons]} \times \text{Emission Factor [kg CO2/metric ton fuel]}$$

For the Marine Diesel Oil used on the tugboats, the CO2 emission factor is 3,206 kg CO2 per metric ton of fuel burnt.

Basis above, then the following tables below show the estimated quantity of CO2 emissions before and after practice implementation:

CO2 emissions - before practice implementation					
Nr of tugs	Power (kw) range groups	Aggregate fuel consumption for 1 tug (mt)/day	Emission factor (kg CO2/m.ton fuel)	Emissions for 1 tug / 1 day (kg CO2)	Total emissions per group of tugs (kg CO2) / day
4	600-1200	0.39	3206.00	1250.34	5001.36
4	1500-2000	0.68	3206.00	2180.08	8720.32
2	2200-2600	1.01	3206.00	3238.06	6476.12
4	3000-3500	1.26	3206.00	4039.56	16158.24
Fleet total emissions for 1 day					36356.04

CO2 emissions - after practice implementation					
Nr of tugs	Power (kw) range groups	Aggregate consumption for 1 tug (mt)/day	Emission factor (kg CO2/m.ton fuel)	Emissions for 1 tug / 1 day (kg CO2)	Total emissions per group of tugs (kg CO2) / day
4	600-1200	0.19	3206.00	609.14	2436.56
4	1500-2000	0.34	3206.00	1090.04	4360.16
2	2200-2600	0.51	3206.00	1635.06	3270.12
4	3000-3500	0.64	3206.00	2051.84	8207.36
Fleet total emissions for 1 day					18274.20

Comparing CO2 emissions before and after green practice implementation for the whole fleet, they are estimated to be reduced by about 18000 kg CO2 for one day, going up to more than half a million kg CO2 for a month.

6. CONCLUSIONS

A. Success of the green practices

Obviously, it is a successful green practice.

The implementation of the minimization of engine running time for tugboats at the Port of Constanța has proven to be a highly effective green practice, delivering substantial economic and environmental benefits. The transition from continuous fuel consumption during idle times to the use of shore power has resulted in significant reductions in fuel costs, estimated at over 100,000 euros per month for a fleet of 14 tugboats. Furthermore, CO2 emissions have been reduced by more than half a million kilograms per month, aligning the port with global sustainability goals and green port policies. These results demonstrate that relatively simple operational adjustments, such as reducing unnecessary engine running time, can lead to substantial positive impacts without requiring significant capital investments.

B. Lessons learned

While the green practice aligns with broader environmental goals, the primary motivator for the towing companies was financial savings rather than ecological responsibility. This highlights the importance of demonstrating the economic viability of green initiatives to encourage their adoption.

The success of this practice was facilitated by cooperation between the port administration, towing companies, and tugboat crews. The port administration's encouragement of sustainability initiatives played a supporting role, while the towage companies benefited financially.

c. Next steps

- Implement educational programs and awareness campaigns for tugboat crews and other stakeholders to reinforce the environmental importance of shore power usage.
- Conduct additional research on energy consumption patterns, shore power efficiency, and potential incentives to maximize economic and environmental benefits.

7. ANNEXES

d. Include relevant supporting materials