



Workshop 2:  
Optimal Routing under the EU  
Emission Trading System

September 6th 2023

# Opening Statement

The shipping sector contributes 3-4% of the EU's total CO<sub>2</sub> emissions and could be responsible for 10-13% of global emissions within a few decades without changes.

As a response to the growing concern about greenhouse gas emissions from the shipping sector, the EU has decided to include shipping in the EU ETS from 2024.

This workshop will provide an overview of the implementation of shipping into the EU ETS and discuss the implications for the industry with focus on Optimal Routing

# Why Shipping will be added to EU ETS ?

- **Climate Goals:** Endorse the EU's commitment to the Fit for 55 package and Paris Agreement, which target a 55% reduction in greenhouse gas emissions by 2030 (compared to 1990 levels) and continued progress toward the 2050 Paris Agreement objectives.
- **Level Playing Field:** Shipping's inclusion in the EU ETS establishes consistent regulations, ensuring fair competition among various industries and creating a level playing field.
- **Emission Reduction Incentives:** By obligating shipping companies to purchase and utilize ETS emission allowances for each ton of CO<sub>2</sub> emitted, this system provides financial incentives for companies to actively reduce their emissions.
- **Innovation and Technology:** Incorporating shipping into the EU ETS framework could stimulate the adoption of cutting-edge technology and innovative practices aimed at reducing emissions within the maritime industry.
- **Revenue for Sustainable Shipping:** Revenue generated through the EU ETS can be channeled into an Innovation Fund, supporting sustainable shipping practices, safeguarding marine ecosystems, and advancing the decarbonization of the maritime sector.

# Emissions to be Reported

- From 2024: cargo and passenger ships of or above 5000 gross tonnage (GT)
- From 2027: offshore ships of or above 5000 GT

## The EU MRV Maritime Regulation:

Within the EU MRV, data is required to be collected, verified and reported on a ship-by-ship basis.

- Carbon dioxide (CO<sub>2</sub>)
- Methane (CH<sub>4</sub>) as of 2024
- Nitrous oxide (N<sub>2</sub>O) as of 2024

## The EU Emission Trading System:

Within the EU ETS, data is required to be collected at the ship level, but then aggregated for verification and reporting at the company level.

- Carbon dioxide (CO<sub>2</sub>)
- Methane (CH<sub>4</sub>) as of 2026
- Nitrous oxide (N<sub>2</sub>O) as of 2026

# Emissions to be Compensated

The system is flag-neutral and route-based. This means it covers emissions from maritime transport as follows:

- all emissions *between* EU ports count 100%;
- all emissions *within* EU ports count 100%, i.e. emissions released at berth and during movements within such a port;
- all emissions from non-EU ports to EU ports count for 50%;
- all emissions from EU ports to non-EU ports count for 50%;

**All emissions between ports outside of the EU are outside the scope of EU ETS.**

Some derogations will apply, for instance for certain voyages to outermost regions or some small islands, or to the benefit of ships using renewable fuels.

# Port of Call Definition

A port of call is the port where a ship stops to load or unload cargo, to embark or disembark passengers, or where an offshore ship stops to relieve the crew. **The following stops are excluded:**

- stops for the sole purposes of refueling,
- stops for obtaining supplies,
- stops for relieving the crew (other than an offshore ship),
- stops for going into dry-dock or making repairs to the ship and/or its equipment,
- stops in port because the ship is in need of assistance or in distress,
- ship-to-ship transfers carried out outside ports,
- stops for the sole purpose of taking shelter from adverse weather or rendered necessary by search and rescue activities,
- stops of containerships in the neighboring container transshipment ports (300nm range) listed in the implementing act to be adopted by the end of 2023.

# How are the Emissions be reported?

## Annual Emissions Reporting

- Companies are required to submit emissions reports annually for each ship under their responsibility.
- They must also provide an emissions report at the company level, aggregating data for ETS purposes.
- Templates for these reports are to be followed, with updated templates available in late 2023.

## Verification of Reports:

- All ship-level and company-level emissions reports must be verified by an accredited verifier.
- Verification needs to be completed by 31 March of the following year.

## Aggregated Emissions Data and Allowance Surrender:

- After the aggregated emissions data at the company level is verified and submitted to the administering authority, companies are required to surrender a corresponding number of allowances.
- Allowances must be surrendered in the Union Registry.
- This allowance surrender process must be completed by 30 September of that year.

# Who has to Compensate the Emissions?

- The EU ETS expansion to maritime sector mandates emissions allowances for all ships at EU ports. Compliance with EU ETS falls to the shipping company (owner, manager, or bareboat charterer)
- In time charter agreements, charterers usually supply and cover fuel costs during the charter period.
- As per BIMCO's ETSA Clause for Time Charter Parties, time charterers hold the obligation and cost of emissions trading allowances. Monthly transfers of allowances to owners are based on ship's emissions data.
- BIMCO's draft clause for time charters aligns emission financial responsibility with the "polluter-pays" principle.



# When can certificates be purchased?

- **EU Emissions Trading System (ETS) and Shipping Companies:** Shipping companies are part of the EU Emissions Trading System (ETS), which allows them to trade emission allowances on the carbon market or through EU ETS auctions. This means they can buy and sell these allowances at any time.
- **Timing of Allowance Transactions:** Shipping companies are not required to wait for the approval of their annual emissions report before purchasing emission allowances. They have the flexibility to engage in allowance trading whenever they choose.
- **Emission Allowance Coverage:** Shipping companies are responsible for ensuring they possess enough emission allowances to cover their own emissions. If they lack sufficient allowances, they can face substantial fines.
- **Yearly Allowance Surrender:** At the conclusion of each year, shipping companies are obligated to surrender an amount of emission allowances that corresponds to their total emissions for that year.

# Options to Reduce Impact of EU ETS

- **Route optimization**
- Adding an extra port call just outside of the EU.
- Changing the order of the ports in the existing schedule such that a port close to the EU is the first port of call in the EU region.
- Removing some EU ports from the schedule and feeding from an EU port.
- A modal shift to modes of transport that are not within the EU ETS scope (currently, this could be road, inland traffic or rail).
- Using vessels under the EU ETS threshold (5000 gross tonnage).
- Using the most fuel-efficient ships for intra-EU trips, while using more polluting ships outside of the EU.

# Tanger Case Study

- Study created by the Technical University of Denmark in Lyngby
- Shifting the hub to Tanger Med's location outside the European Economic Area (EEA) results in 50% lower EU ETS revenues for feeder services compared to using Algeciras as the transshipment hub.
- The case study showcased the potential advantage of considering relocation already at carbon prices as low as 6 EUR/MT of CO<sub>2</sub> (Current Price appx. 90 EUR/MT).
- As a result, a 300-nautical-mile buffer was integrated into the directive.



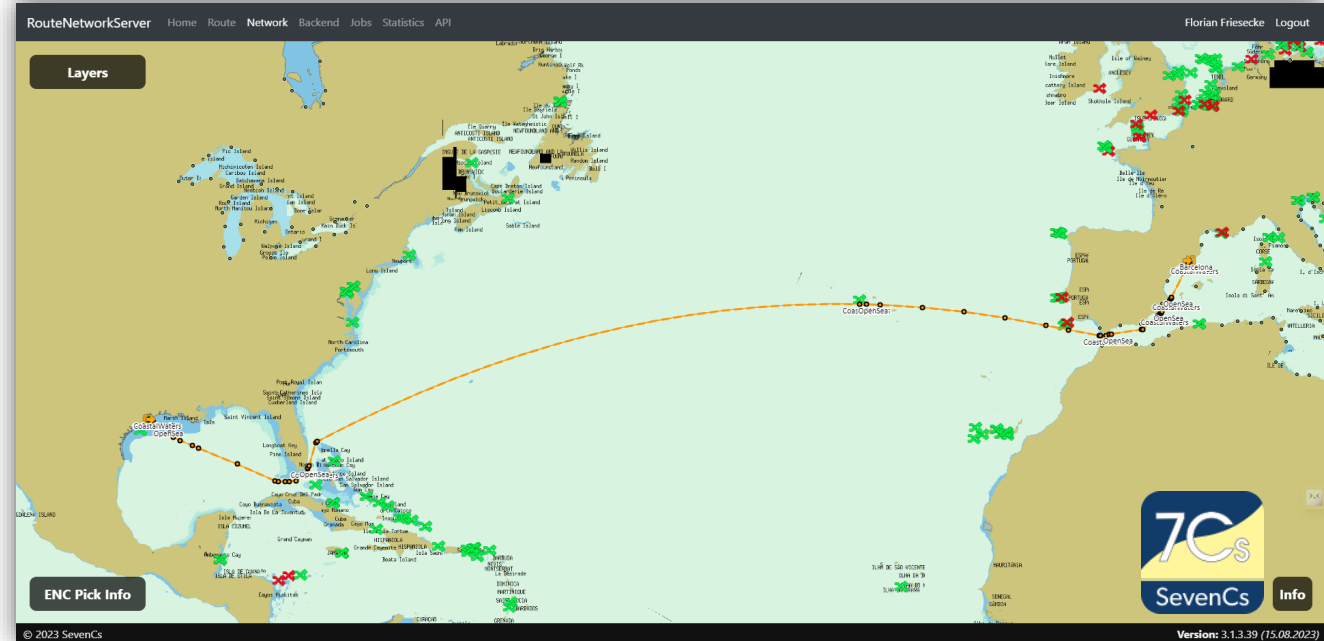
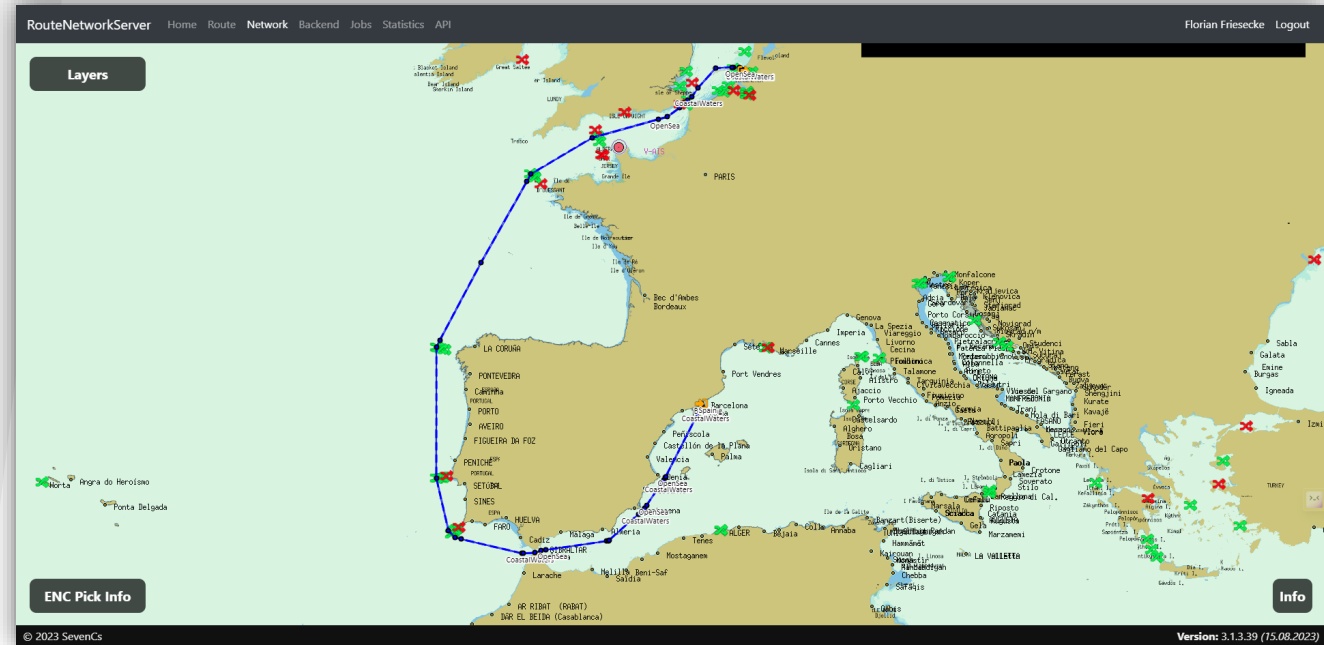
Case Study Source:

[https://www.sciencedirect.com/science/article/pii/S](https://www.sciencedirect.com/science/article/pii/S2666822X22000107)

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# Case Study: Optimizing Routes Between Ports

- **Scenario 1:** Voyage from EU port to EU port.
- **Scenario 2:** Voyage from non-EU port to EU port .
- **Thesis:** Utilizing optimization services leads to heightened cost savings, benefiting not only from fuel reduction but also from reduced invoiced emission volumes.
- Demonstrative examples based on the same used Route Network are provided in the subsequent pages.



# Reference Data: Routing Engine

- **Data-Driven Routing Engine:**  
The product operates as a data driven routing engine for SOLAS Vessels.
- **Data Sources:**  
It relies on a diverse range of data sources with the aim to provide the shortest-safe route.
- **Integrated Services:**  
The routing engine provides access to two additional fully-integrated routing solutions to offer fuel-optimized routes. The integrated services utilize the same data basis for their route calculations.





# Reference Data: Routing Data

- **Diverse Data Sources:**

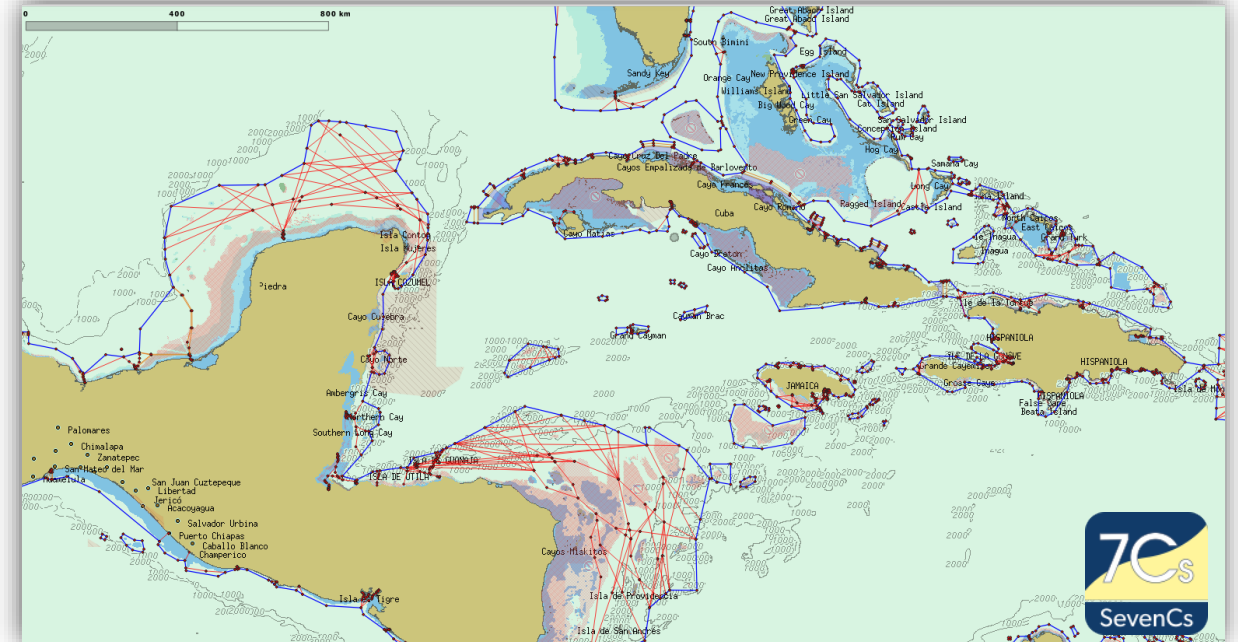
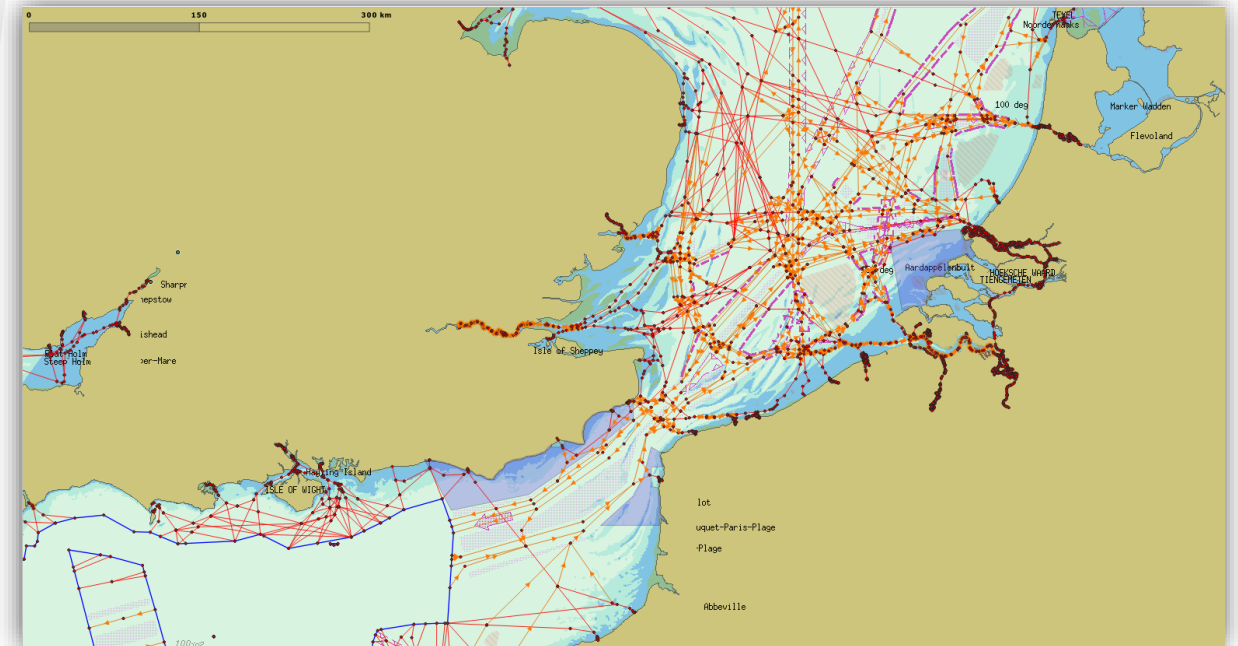
It leverages a variety of sources:

  - Bathymetry
  - Charts
  - Sailing Directions
  - NavArea Warnings
  - T&P Notices
  - Local Authorities' Data
- **Data Enrichment:**

The data is continuously enriched and updated to maintain accuracy and relevance by a group of experience Navigators and Master Mariners.
- **Data Quality Assurance:**

Implemented data quality checks to ensure the reliability of information.
- **Historical Data Analysis:**

Analysis of historical AIS data for route quality optimization.



# Reference Data: Consumption and Emission Costs

Only CO<sub>2</sub> Emissions are considered in the following Case Studies.

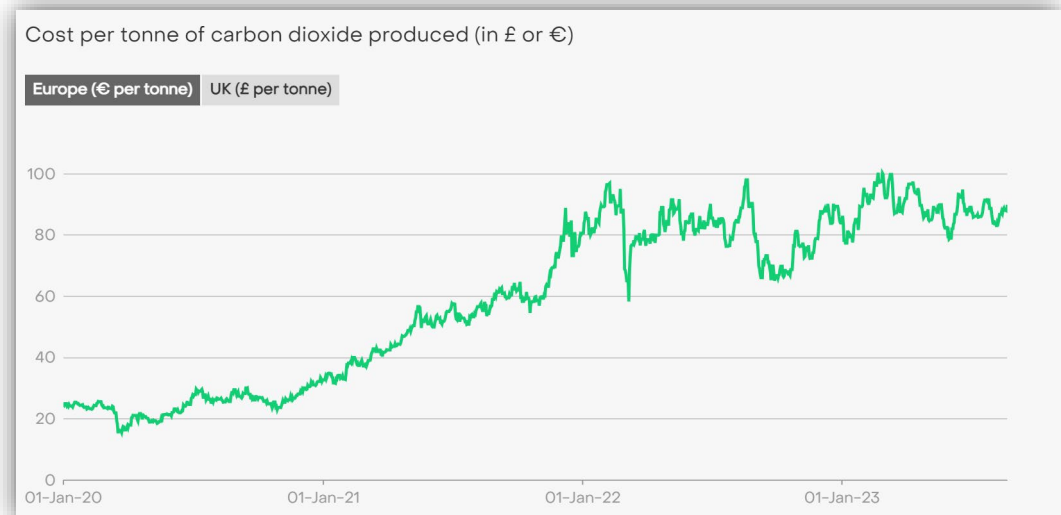
Price	VLSFO	MGO
Current Fuel Price (08/2023)	685\$	991\$
Small Price Gap (01/2022)	685\$	791\$
CO <sub>2</sub> Price (08/2023)	88\$	

**NOTE:**

EU ETS Certificates are traded in EUR. Prices were converted to USD for better comparison.



Source: <https://shipandbunker.com/>



Source: <https://ember-climate.org/>

# Case Study: EU Port– EU Port

Rotterdam – Barcelona

- Scenario 1:  
Shortest Safe Route
- Scenario 2:  
Fuel Optimization



Route	Speed [kts]	Distance [nm]	Out ECA [nm]	In ECA [nm]	Fuel VLSFO [mt]	Fuel MGO [mt]	Fuel Total [mt]	CO2 [mt]
Shortest Route	15	1962	1552	410	108	28	136	431
Fuel Optimized	15	1998	1588	410	105	27	132	417



# Scenario 1: Shortest Safe Route

## Key Facts:

- Total length: 1,962 NM
- Distance in ECA: 11%
- Fuel Consumption: 136 mt
- CO<sub>2</sub> Emissions: 431 mt

## Costs:

- Fuel Costs: 101,208\$
- Emission Costs:
  - 2024: 15,171\$
  - 2025: 26,550\$
  - 2026: 37,928\$



# Scenario 1: Fuel Optimized Route

Key Facts:

- Total length: 1,998 NM (+2%)
- Distance in ECA: 10% (-1%)
- Fuel Consumption: 132 mt (-3%)
- CO<sub>2</sub> Emissions: 417 mt (-3%)

## Costs:

- Fuel Costs: 98,682\$ (-3%)
- Emission Costs:
  - 2024: 14,678\$
  - 2025: 25,687\$
  - 2026: 36,696\$ (-3%)

## Total Savings in 2026:

- Relative: 3%
- Absolute: 3,046\$

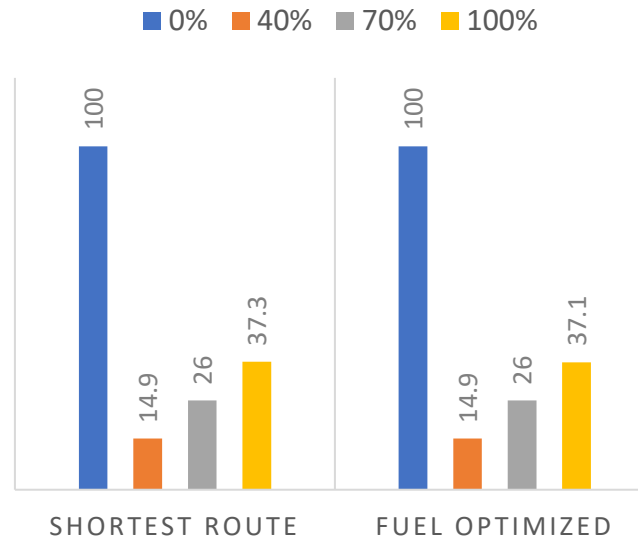


The opportunity to circumvent Emission Control Areas and optimize fuel usage is rather restricted, but it still allows for some cost savings.

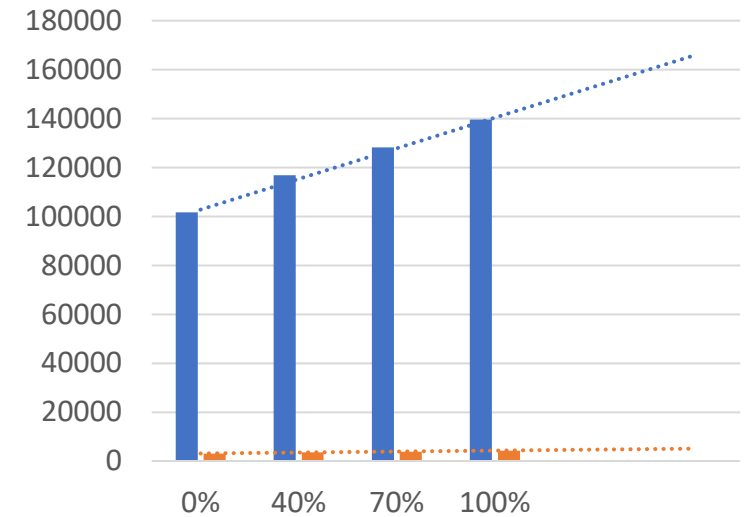
# Summary: Case Study 1

- The inclusion of shipping in the EU ETS will result in added expenses on top of the already elevated fuel costs.
  - Appx. 15% in 2024
  - Appx. 26% in 2025
  - Appx. 37% in 2026
- The actual savings resulting from fuel-optimized routing will rise in proportion to the total fuel and emission costs.

### Impact of EU ETS (%)



### Absolute Savings

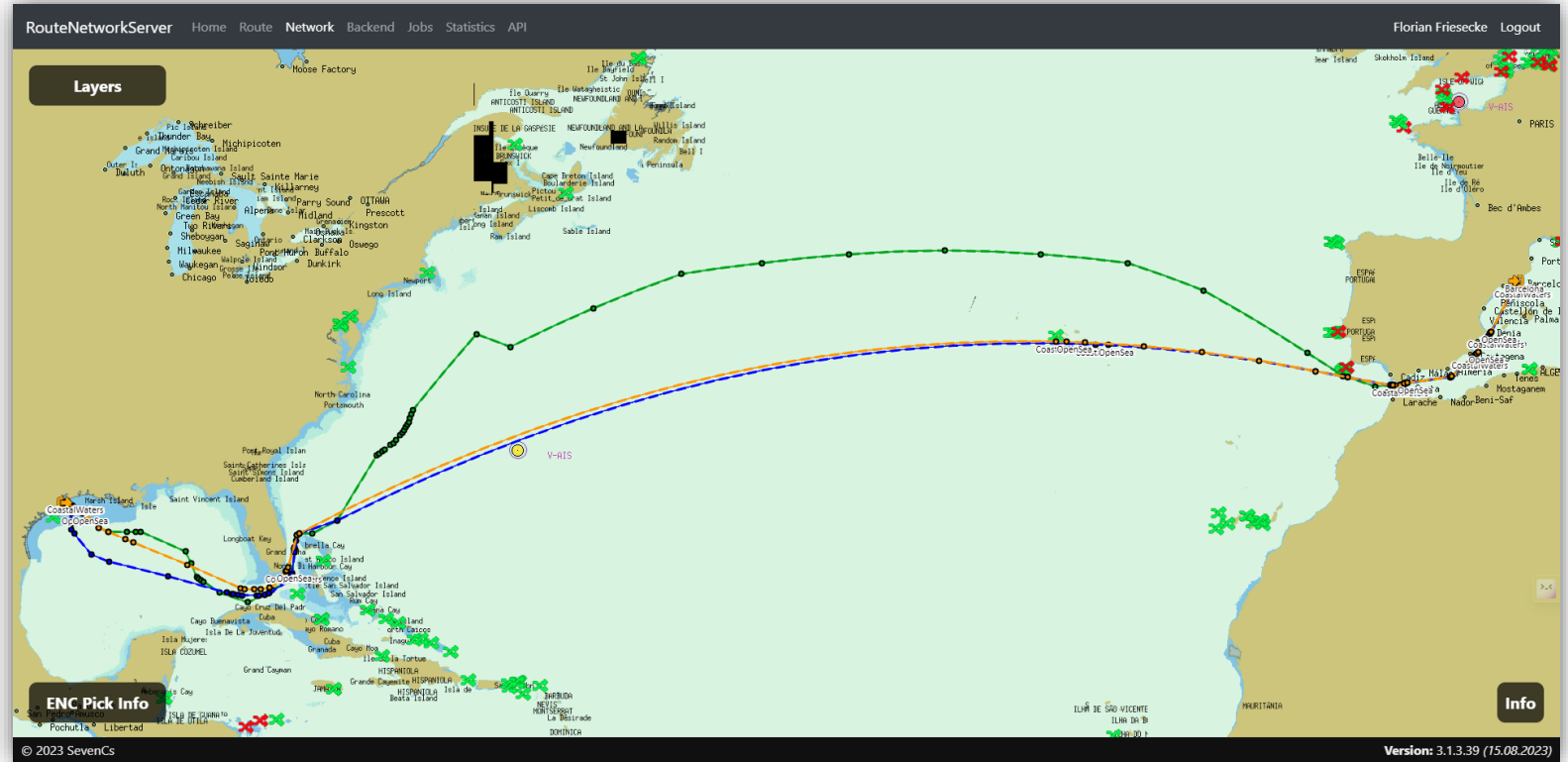


All calculations are based on the current emission certificate price of appx. 90\$. Some forecasts expects price increasement up to 130-160\$ until 2030.

# Case Study: Non-EU Port – EU Port

Houston – Barcelona

- Scenario 1:  
Shortest Safe Route
- Scenario 2:  
Safe Route with minimizing inside ECA time
- Scenario 3:  
Fuel Optimization



Route	Speed [kts]	Distance [nm]	Out ECA [nm]	In ECA [nm]	Fuel VLSFO [mt]	Fuel MGO [mt]	Fuel Total [mt]	CO2 [mt]
Shortest Route	15	5304	4312	991	306	70	376	1191
Minimize ECA	15	5409	5176	233	368	16	384	1210
Fuel Optimized	15	5568	5034	534	305	33	338	1068

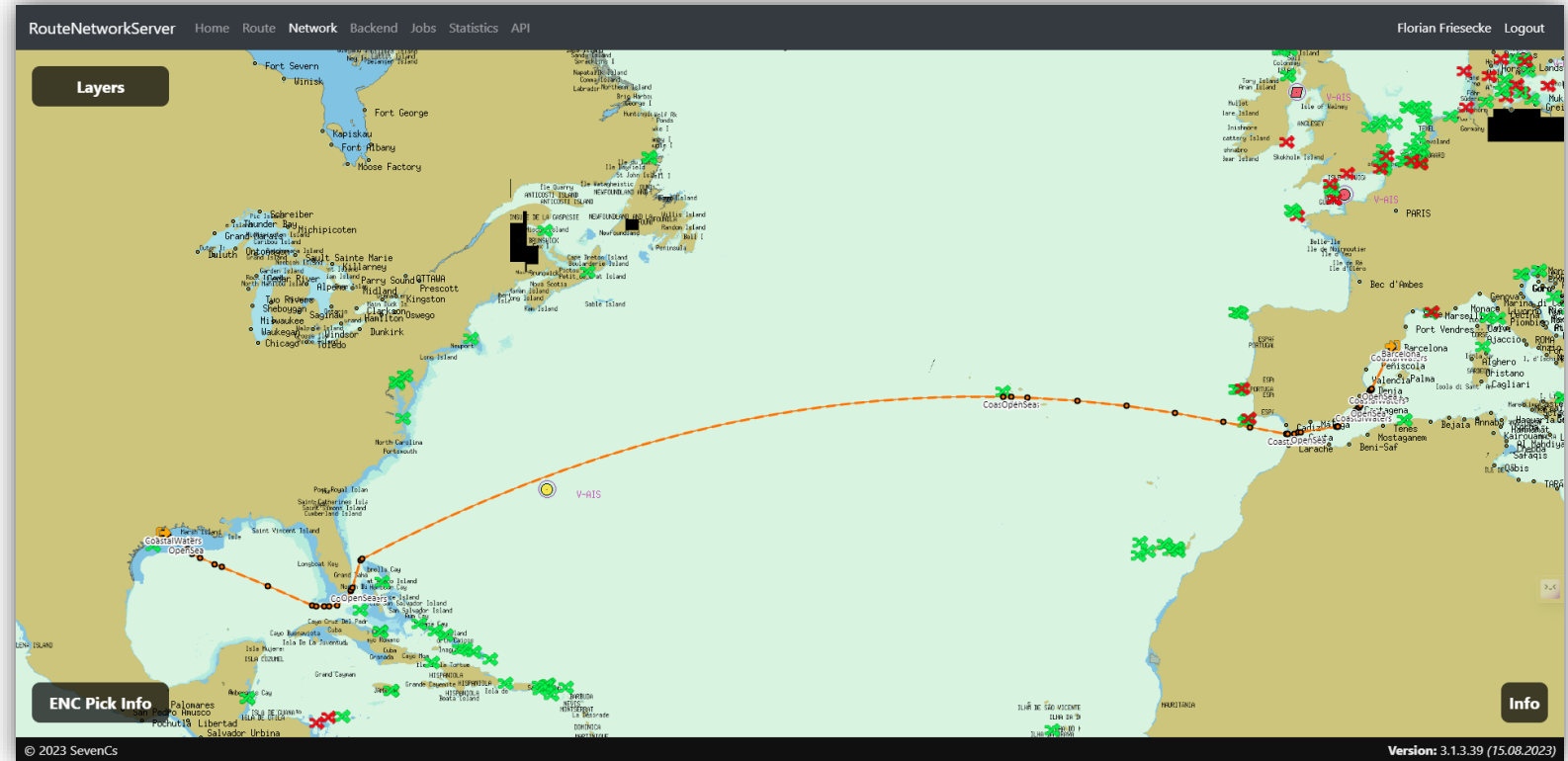
# Scenario 1: Shortest Safe Route

## Key Facts:

- Total length: 5,304 NM
- Distance in ECA: 19%
- Fuel Consumption: 376 mt
- CO<sub>2</sub> Emissions: 1,191 mt

## Costs:

- Fuel Costs: 278,980\$
- Emission Costs:
  - 2024: 20,962\$
  - 2025: 36,683\$
  - 2026: 52,404\$



# Scenario 2: Avoid ECA

## Key Facts:

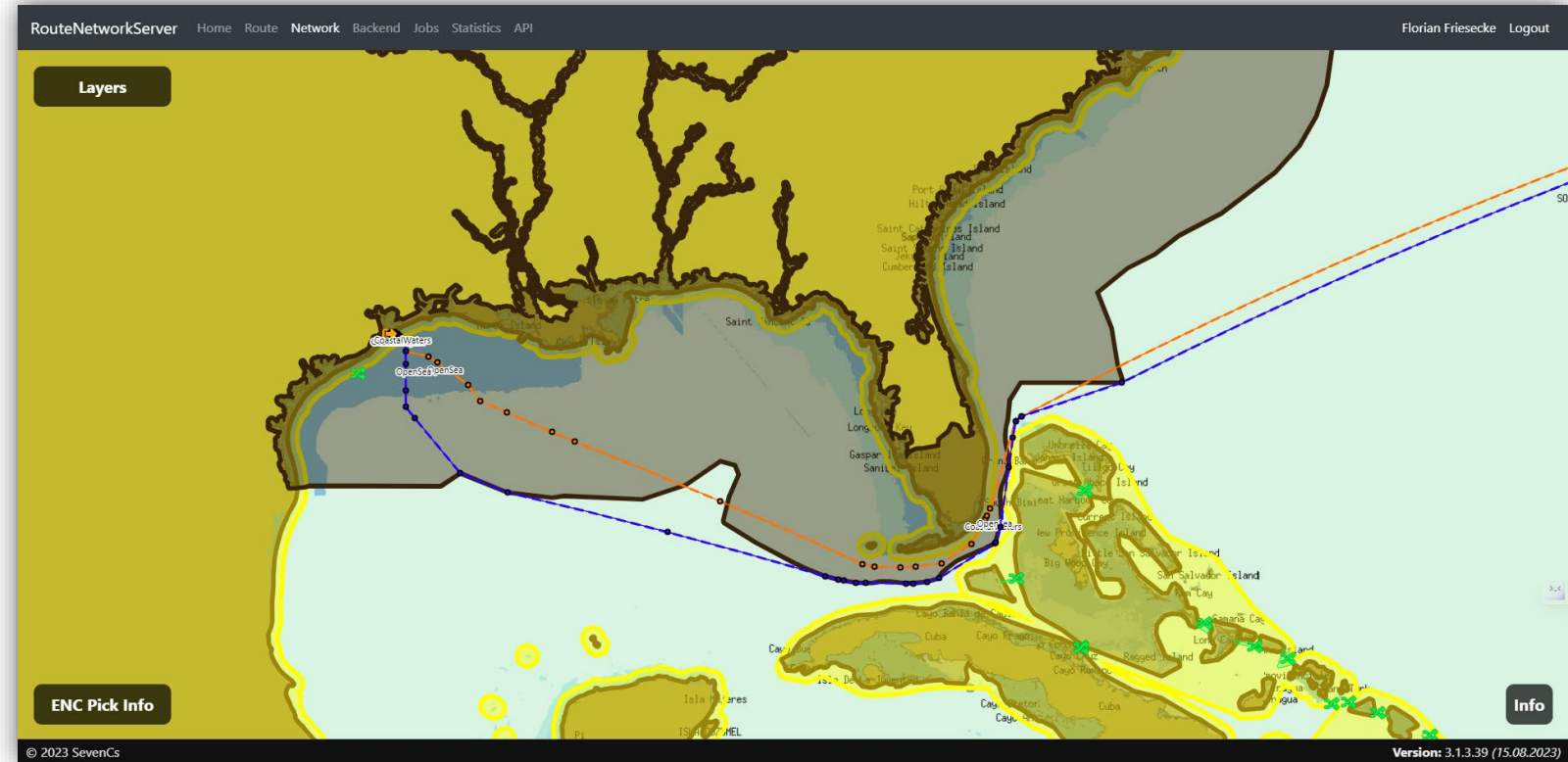
- Total length: 5,409 NM (+2%)
- Distance in ECA: 4% (-15%)
- Fuel Consumption: 384 mt (+2%)
- CO<sub>2</sub> Emissions: 1,210 mt (+1,6%)

## Costs:

- Fuel Costs: 267,936\$ (-4%)
- Emission Costs:
  - 2024: 21,296\$
  - 2025: 37,268\$
  - 2026: 53,240\$ (+1,6%)

## Total Savings in 2026:

- Relative: 3%
- Absolute: 10,208\$



Savings depend heavily on the price difference between VLSFO and MGO fuels. When this difference is minimal, it can lead to increased costs due to emission-related expenses rather than savings.

# Scenario 3: Fuel Optimized Routes

Key Facts:

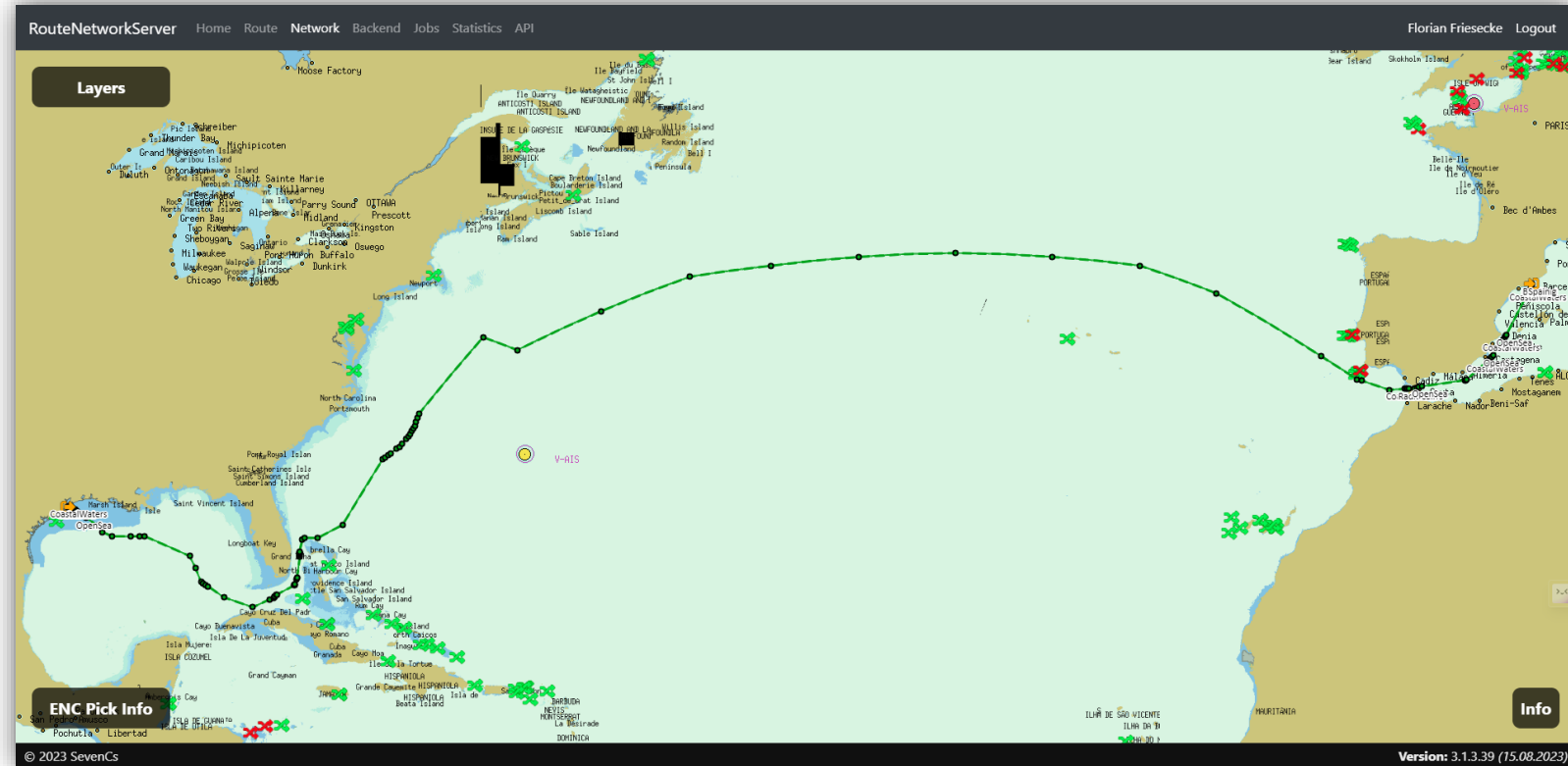
- Total length: 5,568 NM (+5%)
- Distance in ECA: 10% (-9%)
- Fuel Consumption: 338 mt (-10%)
- CO<sub>2</sub> Emissions: 1,068 mt (-10%)

## Costs:

- Fuel Costs: 241,628\$ (-13%)
- Emission Costs:
  - 2024: 18,797\$
  - 2025: 32,894\$
  - 2026: 46,992\$ (-10%)

## Total Savings in 2026:

- Relative: 13%
- Absolute: 42,764\$



Given the present fuel price gap between VLSFO and MGO, the routing engine prioritizes routes outside of the ECA over potential options within the Emission Control Area. Nevertheless, significant savings through fuel-optimized routes are achieved regardless of the fuel price gap's magnitude.



# Scenario 3: Fuel Optimized Routes

Key Facts:

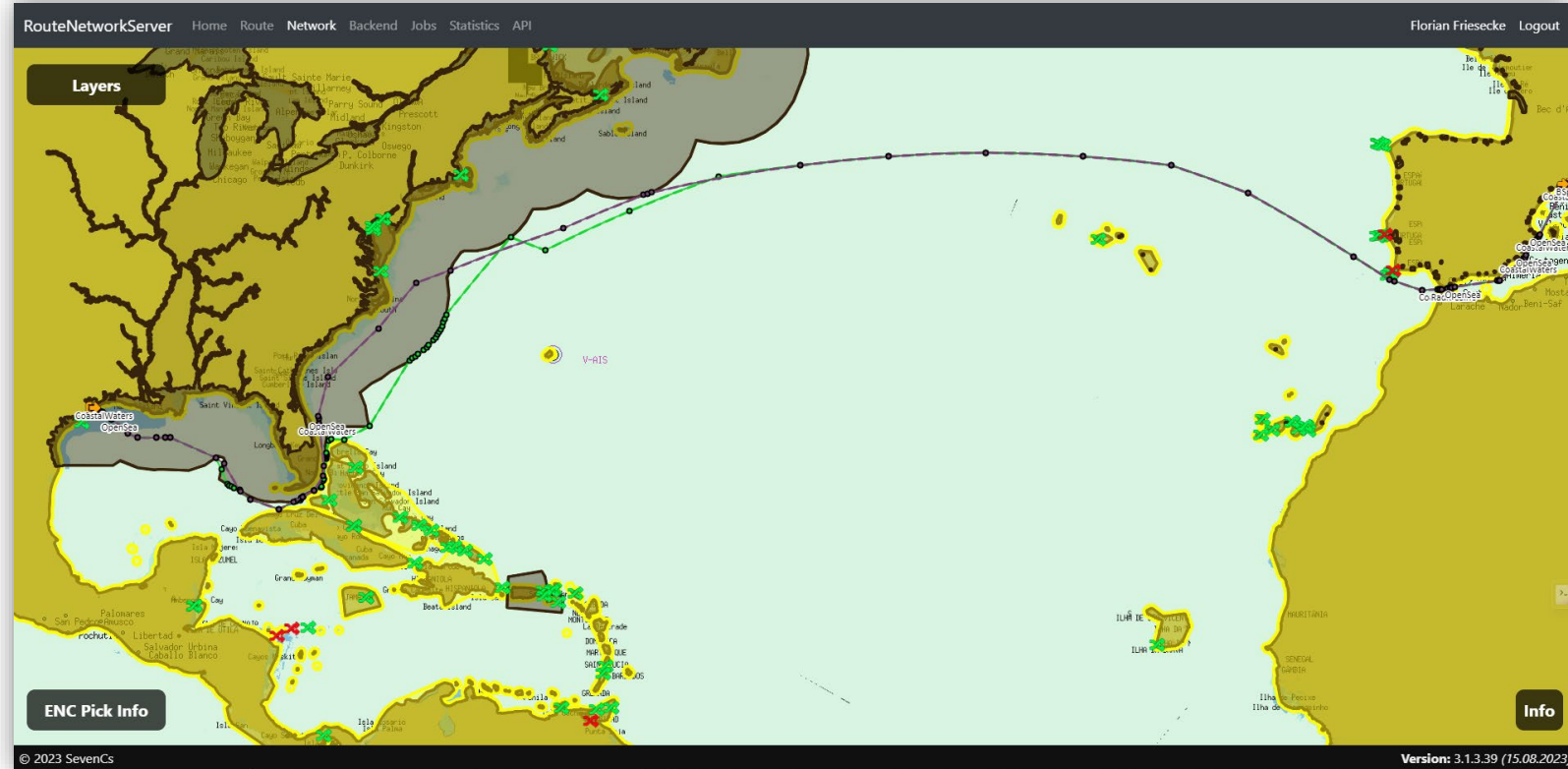
- Total length: 5,568 NM (+5%)
- Distance in ECA: 10% (-9%)
- Fuel Consumption: 338 mt (-10%)
- CO<sub>2</sub> Emissions: 1,068 mt (-10%)

## Costs:

- Fuel Costs: 241,628\$ (-13%)
- Emission Costs:
  - 2024: 18,797\$
  - 2025: 32,894\$
  - 2026: 46,992\$ (-10%)

## Total Savings in 2026:

- Relative: 13%
- Absolute: 42,764\$



With a small fuel price gap, it may not be beneficial to avoid the ECA Zone at the cost of a longer route.

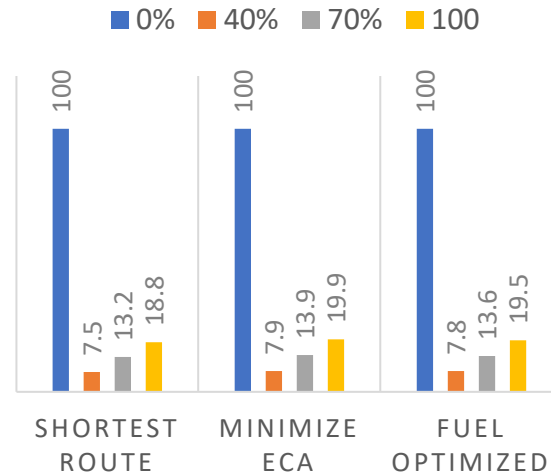
When calculating the same route based on bunker prices from January 2022, where there is a small fuel price gap, the fuel-optimized route is not avoiding the ECA zone (purple route).



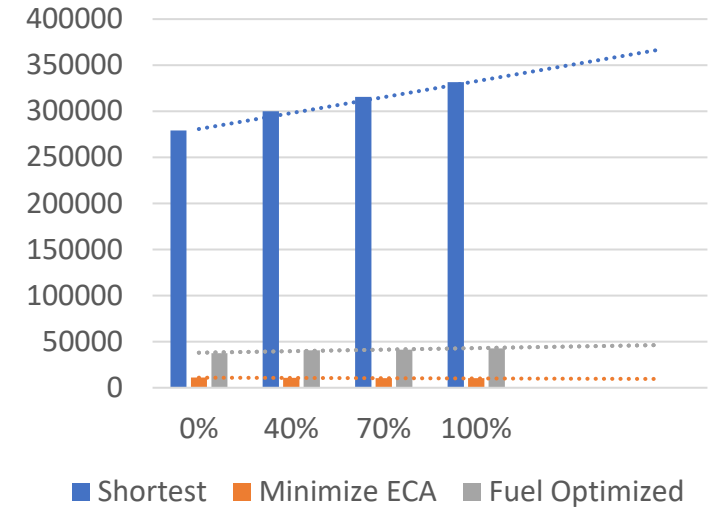
# Summary: Case Study 2

- The inclusion of shipping in the EU ETS will result in added expenses on top of the already elevated fuel costs.
  - Appx. 7.5% in 2024
  - Appx. 14% in 2025
  - Appx. 20% in 2026
- The actual savings resulting from fuel-optimized routing will rise in proportion to the total fuel and emission costs.
- Avoiding ECA may initially have a positive cost impact, but this advantage diminishes or even turns negative if the fuel price gap narrows.

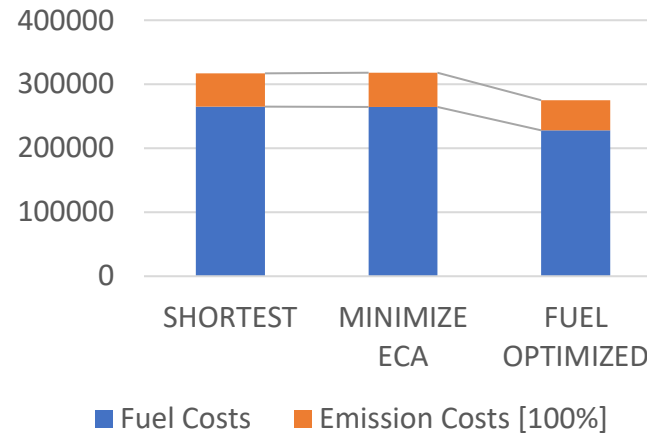
### Impact of EU ETS



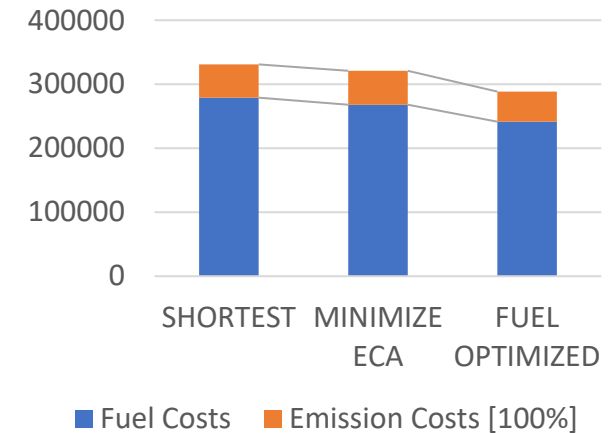
### Absolute Savings



### Small Fuel Price Gap



### Current Fuel Price Gap



# Resources

- [https://climate.ec.europa.eu/eu-action/transport-emissions/reducing-emissions-shipping-sector\\_en](https://climate.ec.europa.eu/eu-action/transport-emissions/reducing-emissions-shipping-sector_en)
- <https://pdfs.semanticscholar.org/2602/ab415c9d6e132e5022d75269517f4c215515.pdf>
- <https://safety4sea.com/sea-cargo-charter-measuring-and-reporting-transparently-is-a-key-step-towards-reducing-emissions/>
- [https://climate.ec.europa.eu/eu-action/transport-emissions/reducing-emissions-shipping-sector/faq-maritime-transport-eu-emissions-trading-system-ets\\_en](https://climate.ec.europa.eu/eu-action/transport-emissions/reducing-emissions-shipping-sector/faq-maritime-transport-eu-emissions-trading-system-ets_en)
- [https://safety4sea.com/wp-content/uploads/2023/04/LR-EU-%E2%80%98Fit-for-55-EU-ETS-and-updates-to-EU-MRV-2023\\_03.pdf](https://safety4sea.com/wp-content/uploads/2023/04/LR-EU-%E2%80%98Fit-for-55-EU-ETS-and-updates-to-EU-MRV-2023_03.pdf)
- <https://www.bimco.org/insights-and-information/safety-security-environment/20220209-reporting-ship-emissions>

# Resources

- [https://www.bimco.org/contracts-and-clauses/bimco-clauses/current/etsa\\_clause](https://www.bimco.org/contracts-and-clauses/bimco-clauses/current/etsa_clause)
- <https://maritimecyprus.com/2022/12/11/dealing-with-the-eu-emission-trading-scheme-bimco-clause-charter-parties-are-you-ready/>
- [https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets\\_en](https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets_en)
- <https://icapcarbonaction.com/en/ets/eu-emissions-trading-system-eu-ets>
- [https://safety4sea.com/wp-content/uploads/2023/04/LR-EU-%E2%80%98Fit-for-55-EU-ETS-and-updates-to-EU-MRV-2023\\_03.pdf](https://safety4sea.com/wp-content/uploads/2023/04/LR-EU-%E2%80%98Fit-for-55-EU-ETS-and-updates-to-EU-MRV-2023_03.pdf)