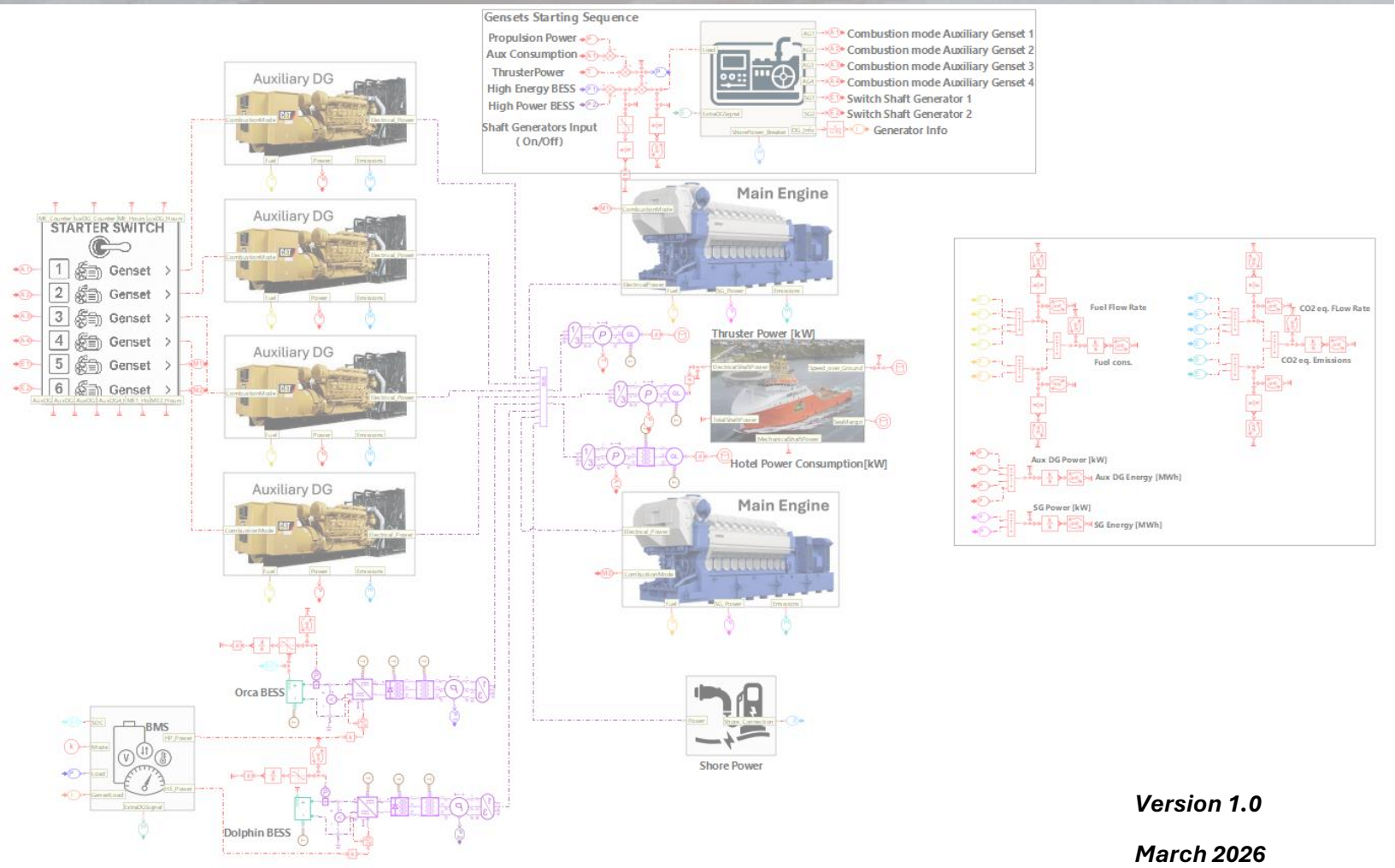
DIGITAL PLATFORM USER MANUAL
NORMAND DROTT



Version 1.0

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Acronyms

Abbreviations	
Aux	Auxiliary
BESS	Battery Energy Storage System
CO_2eq	Carbon Dioxide Equivalent
DG	Diesel Generator
DP	Dynamic Positioning
ECDIS	Electronic Chart Display and Information System
ESS	Energy Storage System
EU GHG	European Union Greenhouse Gas (Emissions)
GHG	Greenhouse Gas
GPS	Global Positioning System
HE	High Energy
HP	High Power
IMO CII	International Maritime Organization Carbon Intensity Indicator
KPI	Key Performance Indicator
MDO	Marine Diesel Oil
MDO CO_2eq WTT	Marine Diesel Oil Carbon Dioxide Equivalent Well-to-Tank
ME	Main Engine
PMS	Power Management System
PTI	Power Take-In
SG	Shaft Generator
SOC	State of Charge
UTC	Coordinated Universal Time

1 Introduction

This guide provides comprehensive instructions for the **NEMOSHIP Digital Platform**, developed as part of the EU NEMOSHIP project. It is designed to assist maritime personnel, both onboard and ashore, in effectively utilizing the platform to optimize the performance and operational efficiency of the vessel ***Normand Drott***.

Figure 1 - Normand Drott Modules

2 Platform Overview

The NEMOSHIP Digital Platform offers a comprehensive suite of tools and features designed to support maritime operations and analytics. The platform comprises the following key modules:

- **Past Simulation and Training**: It utilizes historical trip data to power various simulation scenarios and crew training exercises. This allows users to analyze "what-if" situations by adjusting the configurations of different parameters that were in use onboard during a specific trip.
- **Trip Optimization**: It provides optimization tools that offer PMS advice. This guidance helps users determine the most effective way to utilize batteries, main engines, and auxiliary generators to achieve specific goals, such as minimizing costs, reducing emissions, or finding an optimal balance between the two.
- **Battery Diagnostic Tool**: It delivers specialized functionality for the real-time monitoring and diagnostic assessment of the vessel's battery systems.

3 Past Simulation and Training Module

3.1 Purpose

The **Past Simulation and Training Module** is specifically designed for "what-if" scenario analysis using historical voyage data. This module empowers users to select a specific voyage or a segment of a voyage, modify operational parameters, and then analyze the resulting effects of these changes. The module follows a **three-step process**, and all completed simulations are stored in an **archive section** for future reference and comparison.

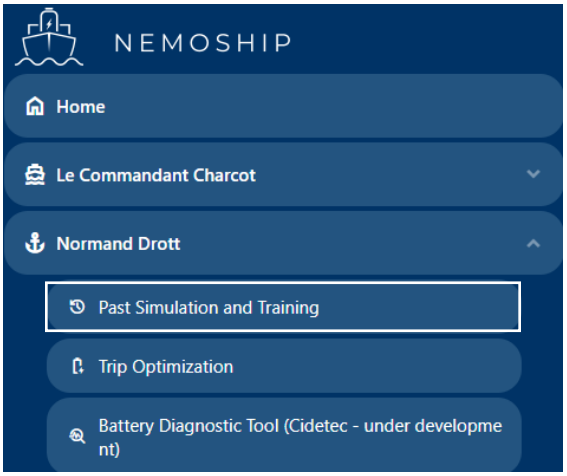

Figure 2 – Past Simulation and Training Module

3.2 Module Structure

3.2.1 Step 1: Select Route

The first step of this module involves **selecting a historical trip**. Users can define the desired trip by specifying a **start date** and **time**, and an **end date** and **time**. These selections are made using two dedicated UI controls on the page. Dates and times should be entered in **dd/MM/yyyy hh:mm** format, using **UTC**.

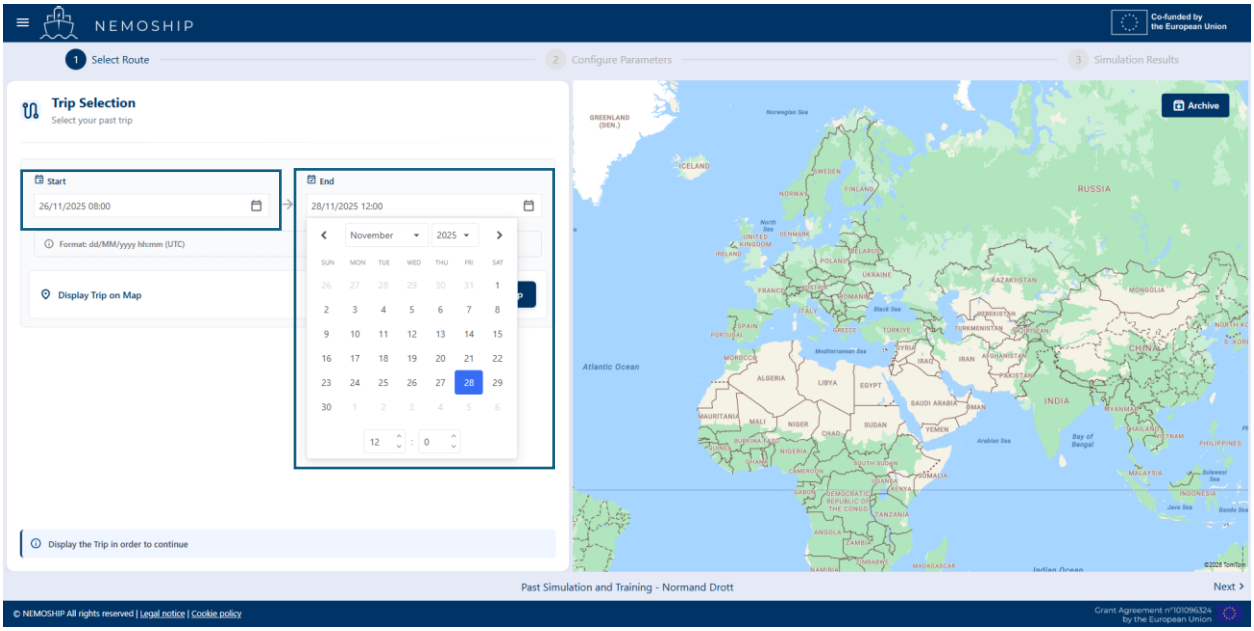

Figure 3 - Past Simulation and Training - Select Trip Dates

Once the dates and times are set, the user must click the **"Display Trip"** button. This action retrieves the trip details for the selected period from Dipai and visualizes the trip on the map located on the right side of the interface.

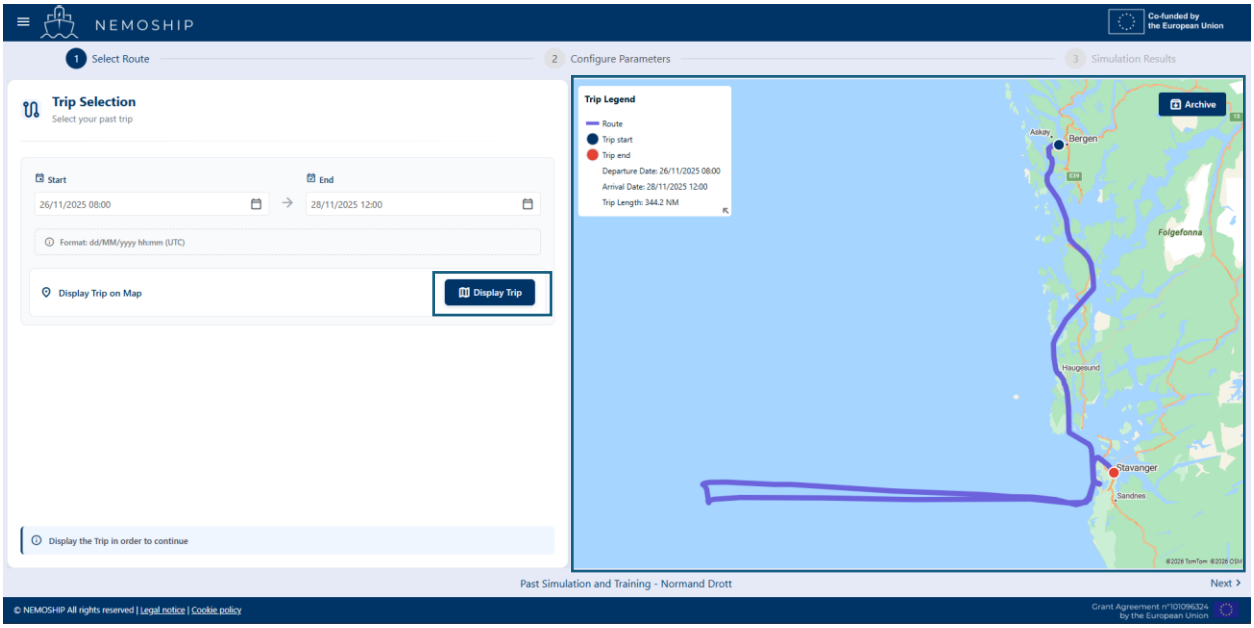

Figure 4 - Past Simulation and Training - Trip Display on Map

After the trip is displayed on the map, users can also view a **legend**. This legend clarifies the visual elements: a blue bullet marks the trip's start, a red bullet indicates the trip's end, and a purple line represents the trip's path. Additionally, the legend provides key trip details, including the start date, end date, and the total length of the trip in nautical miles.

Assuming no errors occurred during this process, the next step in the module will automatically activate. Users can proceed to this next step, **Configure Parameters,** in two ways: either by clicking the "*Next*" button located at the bottom right of the page, or by selecting "**Configure Parameters"** from the step navigation at the top of the page (which appears after the current **Select Route** step).

Archive Access

Before moving to the next step, users also have the option to access the **Archive** by pressing the **"Archive"** button located in the upper right corner. This archive provides access to all previously completed simulations and will be detailed in a future section.

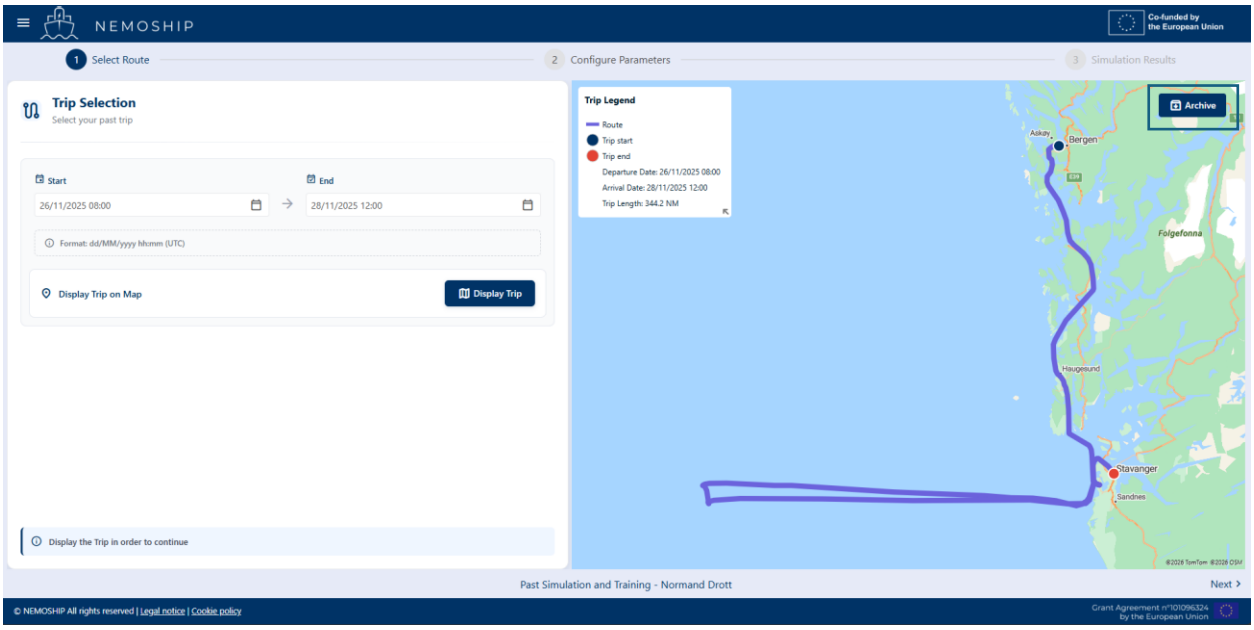

Figure 5 - Past Simulation and Training - Archive Button

3.2.2 Step 2: Configure Parameters

The second step of the module is the **Configure Parameters** page. This page features a dynamic configuration table, designed to empower users to define multiple simulation scenarios simultaneously. The table is intuitively organized, with all configurable parameters displayed in rows, and individual configurations presented in columns. The system allows for the creation and

management of up to 5 distinct configurations within a single simulation, with a minimum requirement of at least 1 configuration to proceed.

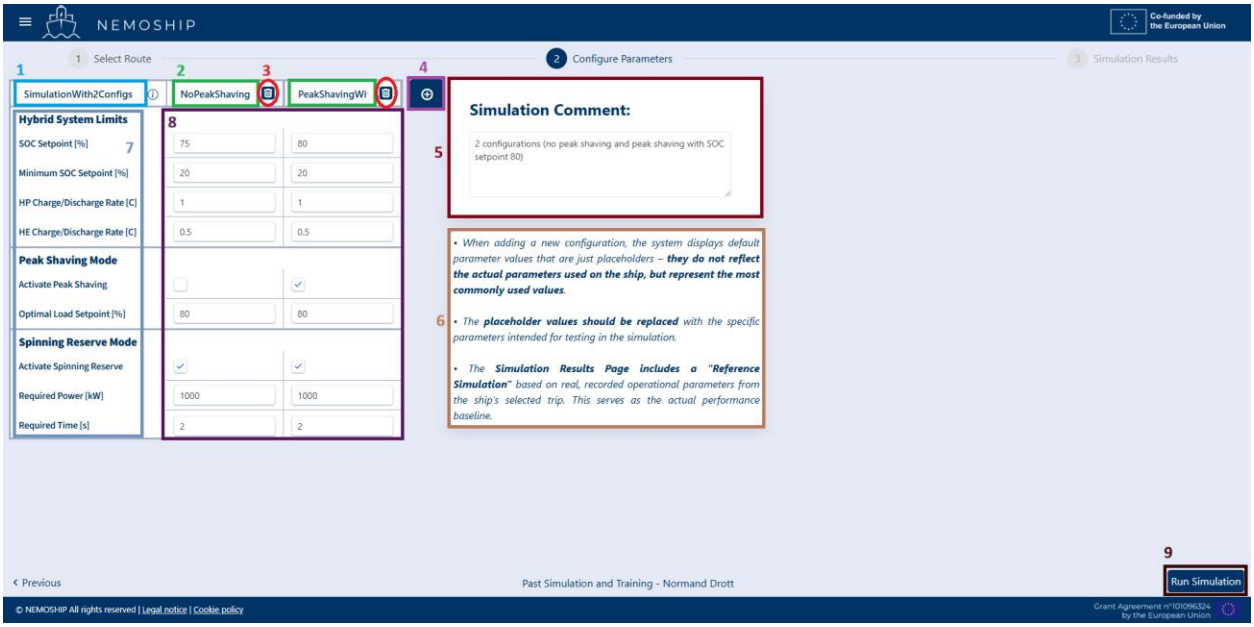

Figure 6 - Past Simulation and Training – Configure Parameters

Interface Elements

The following numbered elements correspond to the interface shown in the image above:

1. **Editable Simulation Name** - By default, this field displays the date and time of access to this step. It can be customized for easier identification and will be visible in the Archive page.
2. **Editable Configuration Name** - Automatically labeled as "Configuration X" (where X is a sequential number). Configurations can be renamed for clarity and easy identification in the Results step.
3. **Delete Configuration Button** - Removes the selected configuration from the table. If an attempt is made to delete the last remaining configuration, a warning message will be displayed, explaining that at least one configuration is necessary to run a simulation.

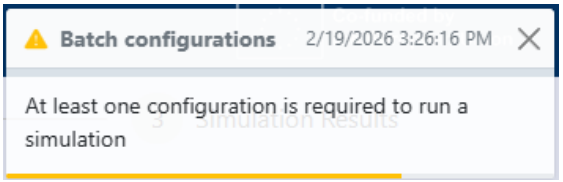

Figure 7 - Past Simulation and Training - Error message when trying to delete the last remaining configuration

4. **Add Configuration Button** - Creates a new configuration column in the table, up to a maximum of 5. Attempts to add more than 5 configurations will result in an error message.

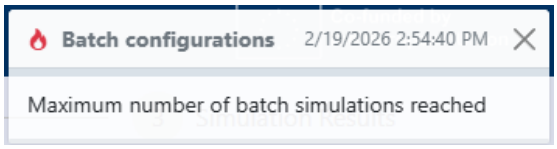

Figure 8 - Past Simulation and Training - Error message when trying to create more than 5 configurations

5. **Simulation Comment Text Area** - Allows for the addition of relevant notes or context for the simulation. These comments will be displayed in the Archive for future reference.
6. **Details Panel** - Provides contextual information and guidance specific to the current step.
7. **Parameter Labels** - Displays the names of the configurable parameters.
8. **Editable Parameter Values** - Input fields where specific values for the parameters are entered.
9. **Run Simulation Button** - Initiates the simulation process. If a progress bar is displayed, the user will be automatically redirected to the third step upon completion of the simulation. Alternatively, if redirected to the Archive, the newly launched simulation will appear as the first entry in the Archive table with an **"In Progress"** status. The status can be updated by utilizing the **"Refresh"** button located on that page. Once the simulation status changes to **"Completed"**, its results can be accessed by selecting the **green eye button**.

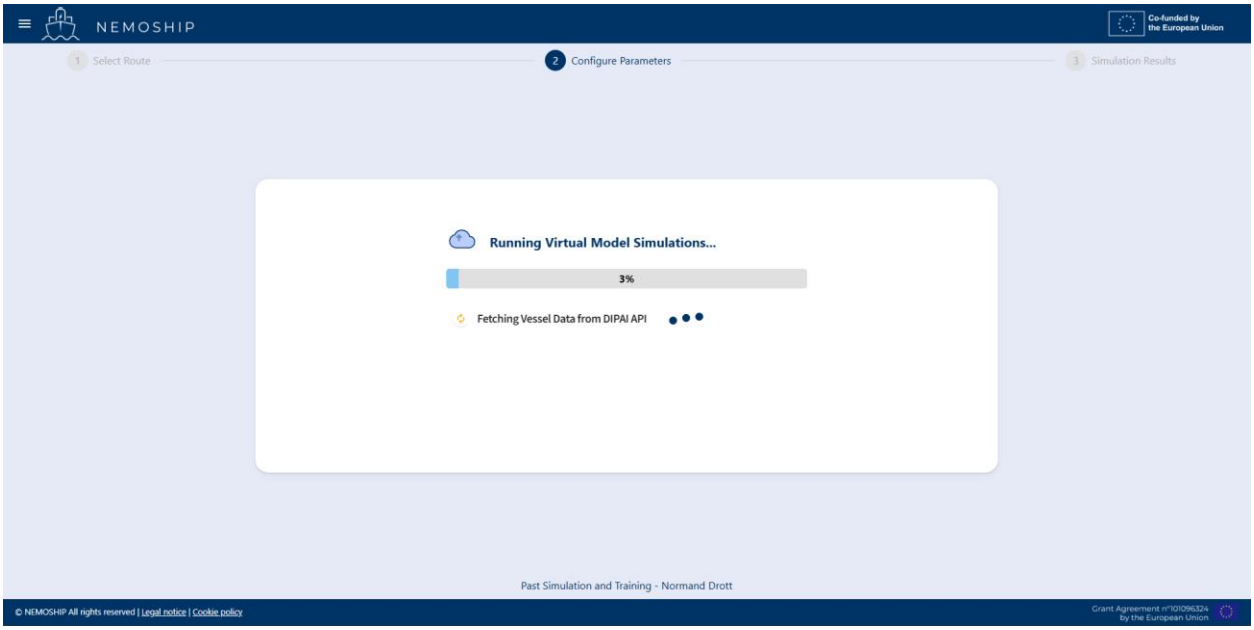

Figure 9 - Past Simulation and Training - Progress Bar

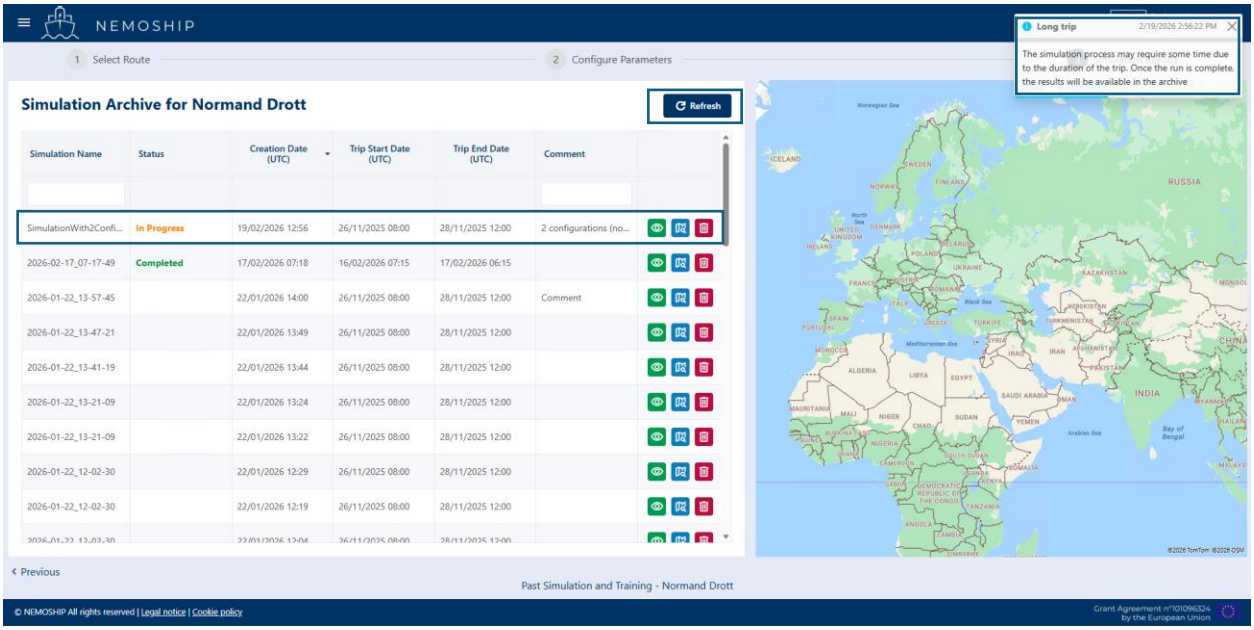

Figure 10 - Past Simulation and Training - Archive Redirect

Configurable Parameters

The editable parameters are organized into three distinct categories. These include details about the hybrid system limits, peak shaving mode settings, and spinning reserve mode settings. Users can activate or deactivate individual modes and configure their specific settings.

Hybrid System Limits

These parameters describe the BESS's general operation and apply to all BESS modes unless overridden by mode-specific settings. They control aspects such as:

- **SOC Setpoint (%)** - Defines the maximum SOC value. The system will tend towards this value after ESS operations.
- **Minimum SOC Sepoint (%)** – Represents the minimum value of SOC. When SOC reaches this value, a new generator is started, to charge the ESS towards SOC Setpoint .
- **HP Charge/Discharge Rate (C)** – Sets the maximum charge & discharge rate for the HP ESS.
- **HE Charge/Discharge Rate (C)** – Sets the maximum charge & discharge rate for the HE ESS.

Peak Shaving Mode

This mode is deactivated by default. If checked it activates the Optimal Load functionality.

- **Deactivation**: If deactivated, the BESS won`t help the system maintain a specific load for the generators. They will work freely without BESS intervention.
- **Activation**: Once Peak Shaving Mode box is checked, the user can define an optimal load for the generators.

- **Operation mode**: When the total system load exceeds the defined optimal load level, the ESS takes its share of the load. It will supply or consume the necessary power to keep generator loading at the optimal level. When SOC reaches “Minimum SOC Setpoint” it will trigger the startup of an extra generator, if available.

Spinning Reserve Mode

The energy in the ESS is used to provide a spinning reserve for the electrical grid. It is activated by default.

- **Activation**: When active the user needs to defined the following inputs:
  - Required Power (kW) – the amount of reserve power needed
  - Required Time (minutes) – the duration for which the reserve power must be available.
  - Using this parameters, the system calculates the necessary backup energy. It then adds that energy requirement on top of the Minimum SOC Setpoint, to ensure that the required backup energy is always available.
- **Deactivation**: If deactivated, the minimum SOC Setpoint used in the simulation is the one defined in Hybrid System Limits.
- **Generators usage**:
  - When active, the system will use the least amount of generators possible for the power demand that exists.
  - When deactivated, the system uses a start sequence for the generators that is based on historical statistics for each recorded activity before battery installation.
    For every specific power level observed, a count was made of how many generators were active.
    The most frequently observed number of started generators for each power level in a given activity is then used to define the number of generators in the simulation. This approach helps to accurately reflect past operational behavior.
    Power level is determined as follows: It is defined by the maximum power a specific number of generators can provide. For Aux DG, power levels are categorized as 0-2000 kW, 2001-4000 kW, 4001-6000 kW, and 6000+ kW. Each category corresponds to the minimum number of generators required to supply the respective power. Similarly, for Shaft Generators (SG), the power levels are 0-4000 kW and 4001+ kW.

3.2.3 Step 3: Simulation Results

The batch simulation runs in the background and comprises multiple individual simulation runs, referred to as "batches." These include:

- **Configuration Batches:** Each configuration that the user defines in the **"Configure Parameters”** step will be set up as a distinct batch configuration and subsequently executed.

- **Reference Batch:** This is an additional simulation designed to emulate the **vessel's actual configuration**, drawing data directly from **Dipai**. The primary purpose of this simulation is to validate the underlying virtual model used within the digital platform. It also provides the user with a fidelity index, demonstrating the model's accuracy. It's important to note that the reference batch does not represent a configuration with default parameters. Instead, it completely bypasses the configurable parameters to precisely replicate real-world vessel operations as they occurred historically. This serves as a crucial baseline for comparison.

Upon completion, the simulation provides comprehensive data for each configuration batch and the reference batch. The application then post-processes this data and presents the results through interactive tables and charts for detailed analysis.

The **"Simulation Results"** page is organized into the following sections:

Measured Trip Performance Data Table

This table presents key performance metrics from the reference simulation (which replicates the real-world configuration), providing a comprehensive overview of actual vessel operations as registered in Dipai:

Diesel Generators (DGs) and Main Engines (MEs) Metrics

- **DG Runtime [h]**: The cumulative time that each auxiliary diesel generator and main engine has been running and producing power.
- **Auxiliary DGs Runtime [h]**: The total cumulative hours during which the auxiliary diesel generators have been actively running.
- **MEs Runtime [h]**: The total cumulative hours during which the main engines have been actively running.
- **Auxiliary DGs Start Cycles**: The total number of times the auxiliary diesel generators were started.
- **MEs Start Cycles**: The total number of times the main engines were started.

Battery Energy Storage System (BESS) Metrics

- **BESS Equivalent Cycles**: This metric quantifies the BESS usage, representing the number of equivalent full charge-discharge cycles. It is calculated by dividing the total energy discharged by the BESS by its rated energy capacity. This value is provided for both High Power Battery and High Energy Battery.

Fuel and Emissions Data

- **Fuel Consumption:** The amount of fuel consumed by all generators and main engines over the selected period.

- **GHG Emissions:** The total quantity of greenhouse gases released into the atmosphere over the selected period.

Measured Trip Performance Data

DG Runtime [h]	DG1	DG2	DG3	DG4	ME1	ME2
	13.75	10.30	3.03	11.12	0.00	32.72
DGs/MEs Runtime [h]	Aux DGs			MEs		
	38.20			32.72		
DGs/MEs Start Cycles	Aux DGs			MEs		
	10.00			3.00		
BESS Equivalent Cycles ⓘ	High Power Battery			High Energy Battery		
	2.35			4.86		
Fuel and Emissions Data [t]	Fuel Consumption			GHG Emissions		
	40.99			131.42		

Figure 11 - Past Simulation and Training - Measured Trip Performance Data (Dipai)

Map

On the right side of the screen the map displays the analyzed trip together with the legend that contains details about the trip.

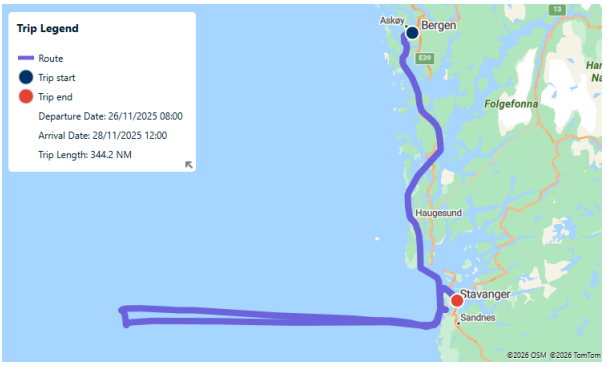

Figure 12 – Past Simulation and Training - Map

Parameters Impact Overview Panel

This section provides a comprehensive comparison between the user-set configurations and the reference simulation:

- **Shaft Power Fidelity Index:** This indicates how accurately the virtual model's simulated shaft power profile matches the actual shaft power profile from Dipai.
- **Metrics Comparison Table:** This displays the difference between each configuration's metric values and the reference simulation's values, enabling quick identification of performance improvements or degradations.
- **Parameters Review Button:** This opens a pop-up window showing the parameters that were modified in the Configure Parameters step for each configuration, with changes highlighted for easy identification.
- **Data Download Button:** This exports the complete batch simulation dataset, including data for all configuration batches and the reference batch, for external analysis.

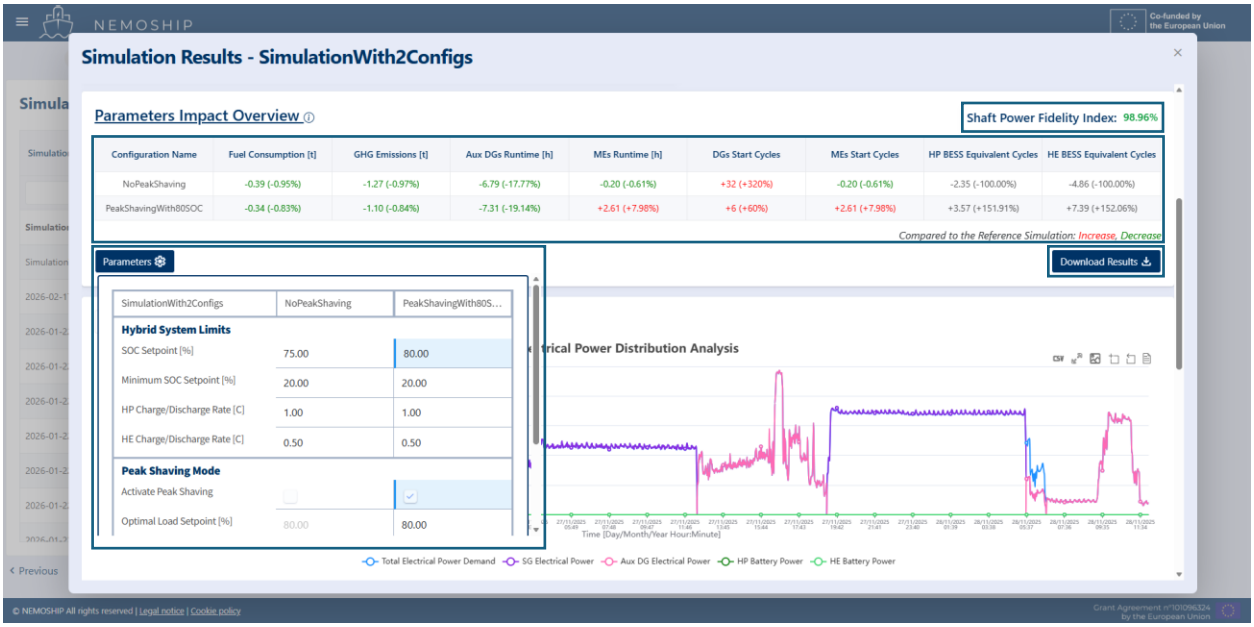

Figure 13 - Past Simulation and Training - Parameters Impact Overview

Electrical Power Distribution Analysis Chart

The **Electrical Power Distribution Analysis** chart is an interactive time-series chart that allows the user to monitor and analyze the evolution of the electrical power distribution over time for each defined configuration, plus the reference batch. The user can change the configuration for which the plot is displayed by using the dropdown from the top left of the section. The plot includes:

- **Total Electrical Power Demand [kW]:** Shows the overall electrical power consumption trend throughout the selected period of time.
- **SG Electrical Power [kW]:** Represents the power supplied by the Shaft Generators.

- **Aux DG Electrical Power [kW]:** Represents the power supplied by the Auxiliary Diesel Generators.
- **HP Battery Power [kW]:** Illustrates the power provided by the High Power Battery.
- **HE Battery Power [kW]:** Illustrates the power provided by the High Energy Battery.

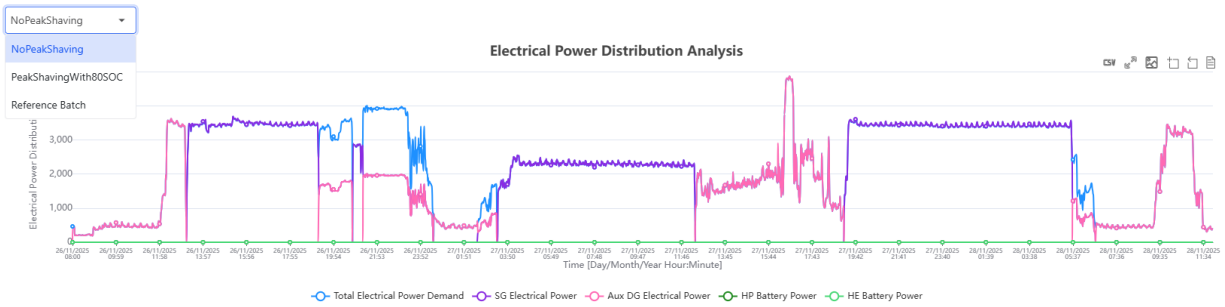

Figure 14 - Past Simulation and Training - Electrical Power Distribution Analysis Chart

Left Multi-Chart Controller

This controller allows users to switch between different time-series performance charts using a dropdown menu. The user can choose to analyze the following key performance metrics and visualize detailed analyses by pressing the **"Details"** button.

Fuel Mass Flow Rate Analysis Chart

This chart quantifies **the rate of fuel consumption**, expressed in kilograms per hour (kg/h), for:

- Each user-defined configuration
- The reference batch
- The real data from Dipai

By pressing the **"Details"** button from the top right of this section, the user can visualize a **detailed analysis of Fuel Consumption** that includes:

- Total fuel consumed for each configuration and for the reference batch, expressed in metric tons.
- Differences between the values obtained in the set configurations and the reference value.
- Percentage differences indicating how much the configuration value varies from the reference value, expressed as a percentage of the reference.

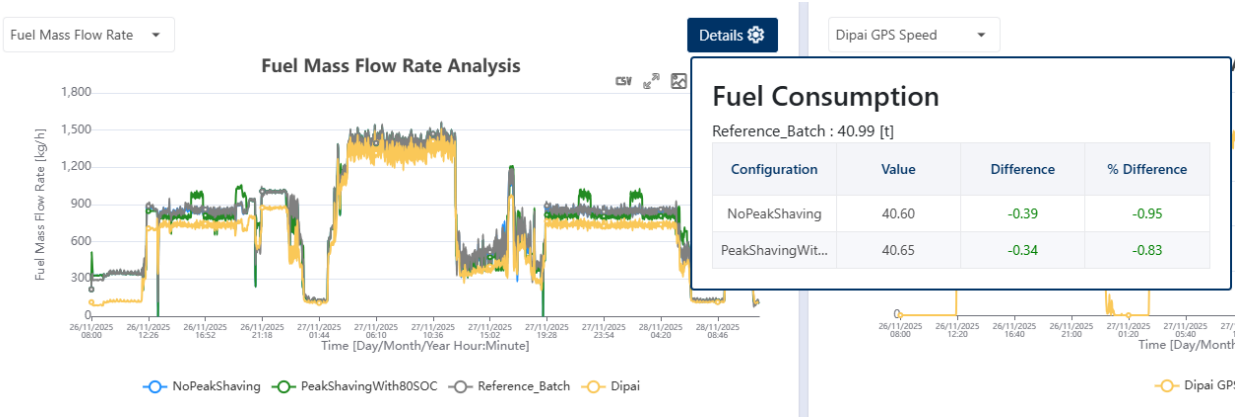

Figure 15 - Past Simulation and Training - Fuel Mass Flow Rate Analysis Chart and Details

Aux DG & SG Electrical Power Analysis Chart

This chart reveals the **electrical output power delivered by the Auxiliary DGs and the Shaft Generators** over time for every configuration, for the reference batch, and for the real data from Dipai.

The **"Details"** button can be pressed to see a detailed analysis of the **Electrical Energy delivered by the Diesel Generators and the Shaft Generators**. This analysis includes:

- Total electrical energy for each configuration and for the reference batch, expressed in MWh.
- Differences between the values obtained in the set configurations and the reference value.
- Percentage differences indicating how much the configuration value varies from the reference value, expressed as a percentage of the reference.

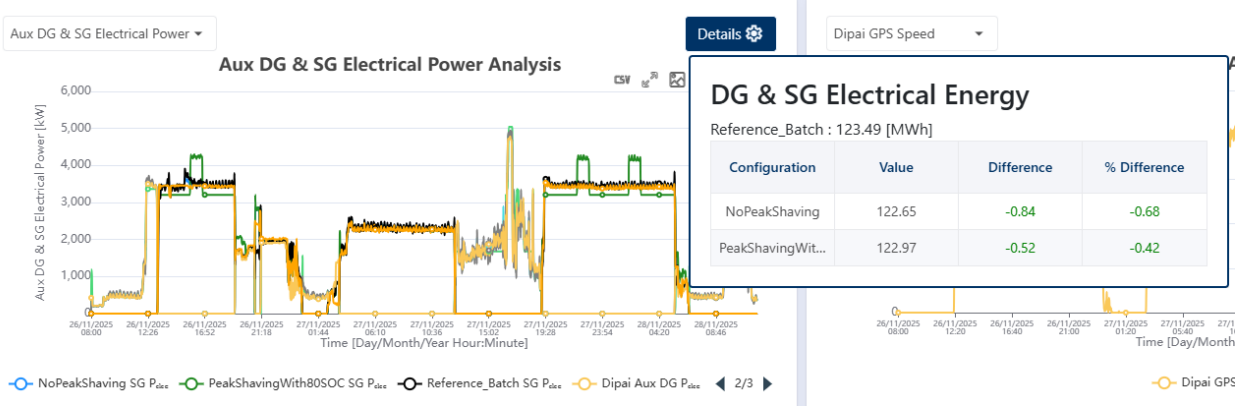

Figure 16 - Past Simulation and Training - Aux DG & SG Electrical Power Analysis Chart and Details

HP & HE Batteries SOC Analysis Chart

This chart displays the **State of Charge (SOC)** of both **high-power batteries** and **high-energy batteries** over time for each configuration, together with the real data from Dipai.

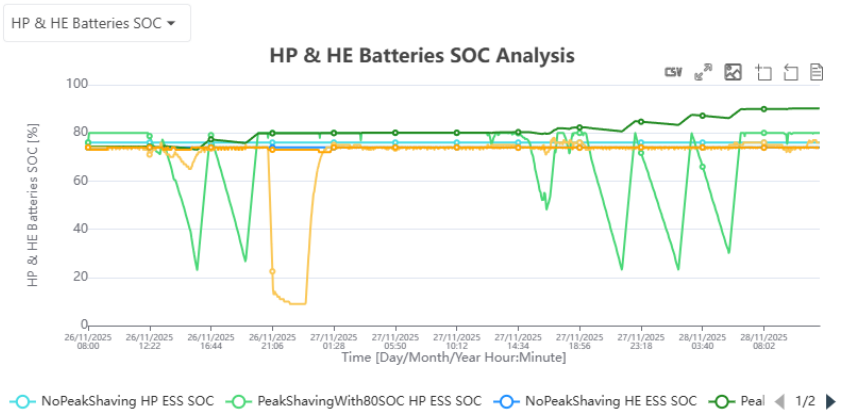

Figure 17 - Past Simulation and Training - HP & HE Batteries SOC Analysis Chart

Right Multi-Chart Controller

Similar to the left-side controller, this section allows the user to switch between different performance metrics using the dropdown menu from the top left of the section.

GHG Emissions Mass Flow Rate Chart

This chart compares **greenhouse gas emissions** over time for each user-defined configuration and the reference batch.

The **"Details"** button shows the analysis of the **GHG Emissions**, including:

- Total emissions for each configuration and for the reference batch, expressed in metric tons.
- Differences between the values obtained in the set configurations and the reference value.
- Percentage differences indicating how much the configuration value varies from the reference value, expressed as a percentage of the reference.

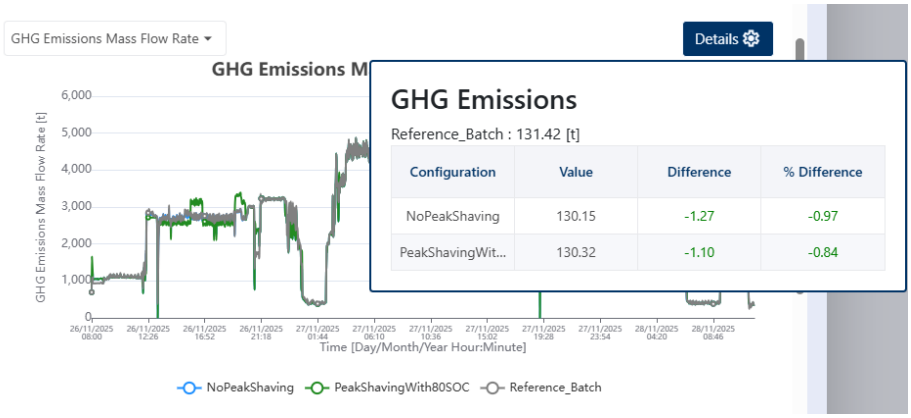

Figure 18 - Past Simulation and Training - GHG Emissions Mass Flow Rate Analysis and Details

Dipai GPS Speed Chart

This chart allows the user to visualize the vessel's speed over ground throughout the selected period.

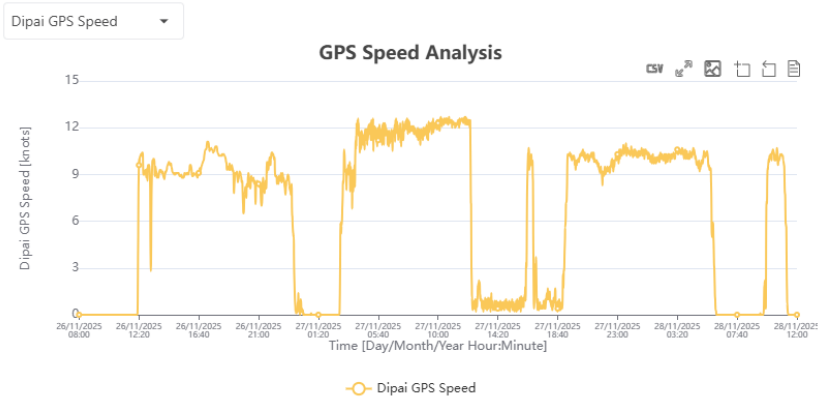

Figure 19 - Past Simulation and Training - GPS Speed Analysis

Propulsion Power Distribution Analysis Chart

The Propulsion Power Distribution Analysis chart is an interactive time-series chart that allows the user to monitor and analyze the evolution of the propulsion power over time. The plot displays the **total propulsion power** with a black line, while the blue and green bars fill the space under the plot, representing the **PTI propulsion power** (blue) and **ME propulsion power** (green).

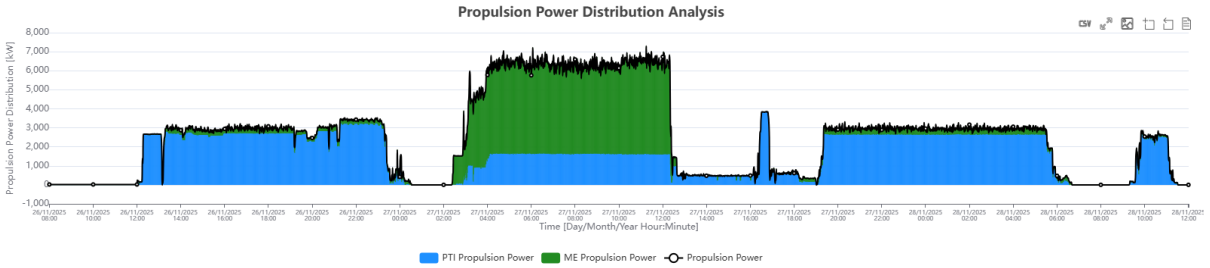

Figure 20 - Past Simulation and Training - Porpulsion Power Distribution Analysis Chart

3.3 Archive

The **Simulation Archive** provides users with centralized access to all previously executed simulations within the Past Simulation and Training module. Each user can view only their own simulations, ensuring data privacy.

The archive displays a detailed table containing key information about each simulation, making it easy to identify and access details about it. The page also contains a button that allows the user to navigate back to the first step of the Past Simulation and Training module.

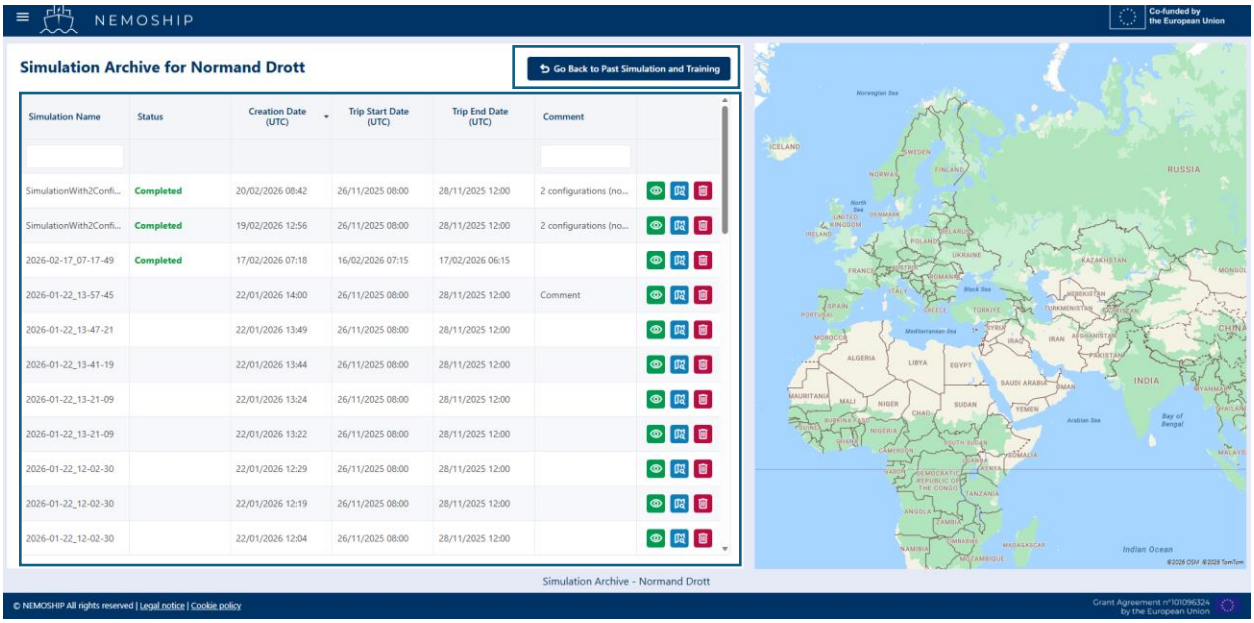

Figure 21 - Past Simulation and Training – Archive

Archive Table Columns

- **Simulation Name:** The name of the simulation (either the default name or the user-defined name).

- **Status:** The current status of the simulation, which can be one of the following:
  - **Completed:** For simulations that finished successfully.
  - **In Progress:** For simulations that are still running.
  - **Error:** In case of errors that occurred while performing the simulation.
- **Creation Date:** The date on which the simulation was created.
- **Trip Start Date:** The starting date of the analyzed period.
- **Trip End Date:** The end date of the analyzed period.
- **Comment:** Any comment added by the user.
- **Actions:** A column containing three action buttons for managing each simulation:
  - The first button *(See Results)* opens a new window displaying the complete simulation results, presenting an identical interface to the **Simulation Results** page previously described.

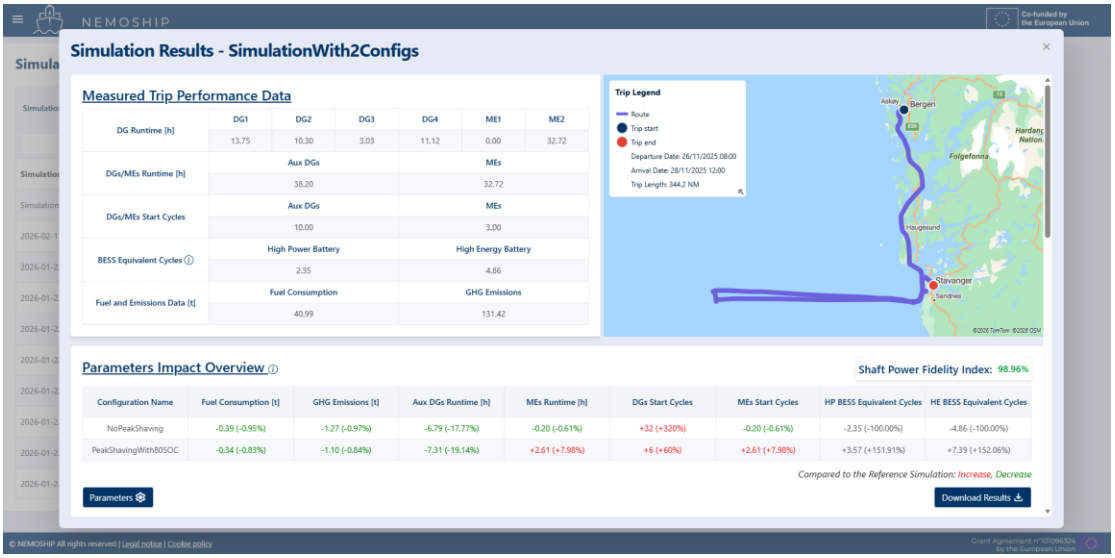

Figure 22 - Past Simulation and Training - Archive Simulation Results

- The second button *(See trip)* visualizes the trip route on the map display on the right side.

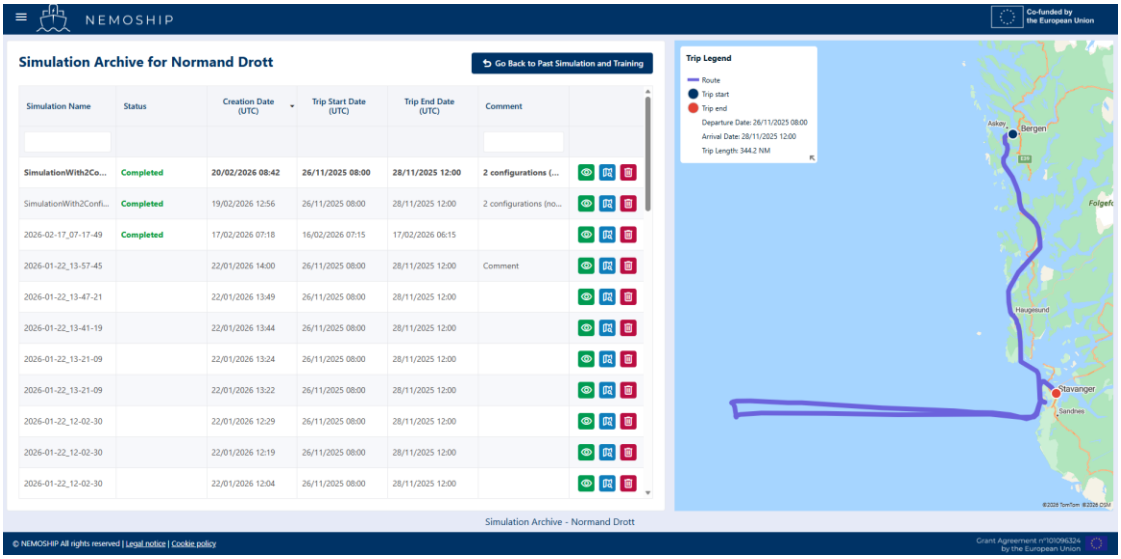

Figure 23 - Past Simulation and Training - Archive Trip Display on Map

- The third button allows users to permanently delete the simulation results from their archive.

4 Trip Optimization Module

4.1 Purpose

The **Trip Optimization Module** is designed to optimize an entire trip, providing valuable insights on how to operate the ship most effectively. This optimization can focus on **reducing costs**, **minimizing emissions**, or achieving a **balanced combination of both objectives**, depending on specified priorities.

This module is specifically engineered for real-time application during current voyages, offering immediate insights and recommendations on how to efficiently utilize the vessel's power management system. Beyond serving as a planning tool for future trips, this module delivers actionable guidance for ongoing operations, empowering crew members and operators to make informed decisions about power distribution, generator usage, and battery management while the vessel is actively navigating its route.

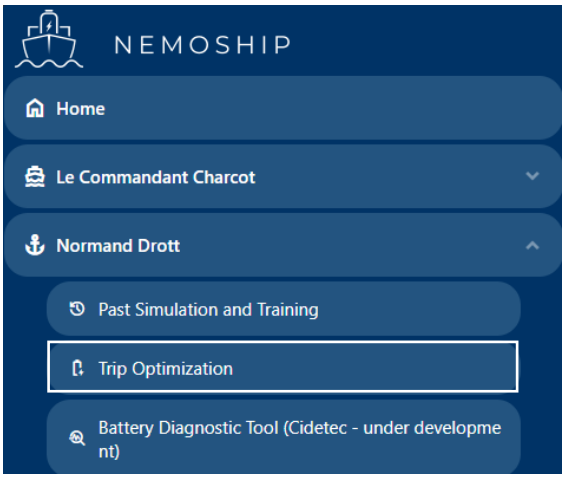

Figure 24 - Trip Optimization Module

4.2 How It Works

For a given **route**, the platform integrates **weather data** from an external provider (Open Meteo) and analyzes the vessel's specified **activities** to predict its required **power profile**. Using this determined power profile, alongside user-defined **optimization constraints**, the platform provides intelligent insights on how to **efficiently manage battery and generator systems**. This ensures the most cost-effective and/or emission-efficient operation possible.

4.3 Module Structure

The module consists of **4 sequential steps**. Each step depends on the completion of the previous one, meaning that until all required actions in the current step are completed, the next steps remain blocked (appear greyed out).

Users can navigate through the module in two ways:

- **Step names** - Click on the step names displayed at the top of the screen (this option is not always available, depending on the type of action that will be done)
- **Navigation buttons** - Use the *Previous* and *Next* buttons located at the bottom of the screen

Figure 25 – Trip Optimization Steps

4.3.1 Step 1: Define Route

This step allows users to import a route for trip optimization. The route file must be a **CSV** file generated from **ECDIS** and adhere to a specific format.

The CSV file must contain **11 columns** in the following order: **WP**, **Lat.**, **Lon.**, **Dist.(NM)**, **Brg.**, **Spd(Knot)**, **Lane(NM)**, **Turn(NM)**, **Delay(min)**, **LegTime(min),** and **Notes**.

	A	B	C	D	E	F	G	H	I	J	K
1	WP	Lat.	Lon.	Dist.(NM)	Brg.	Spd.(Knot)	Lane(NM)	Turn(NM)	Delay(min)	Leg time(min)	Notes
2	1	60°24.174'N	005°18.260'E	1,8	271,5°	10,0	0,09	0,21	0	11	
3	2	60°24.221'N	005°14.563'E	0,8	239,3°	10,0	0,04	0,21	0	5	
4	3	60°23.816'N	005°13.184'E	1,9	234,4°	10,0	0,10	0,21	0	11	
5	4	60°22.669'N	005°09.945'E	1,1	175,1°	10,0	0,05	0,21	0	6	
6	5	60°21.717'N	005°10.111'E	1,1	173,9°	10,0	0,05	0,21	0	7	
7	6	60°20.499'N	005°10.373'E	0,7	124,5°	10,0	0,05	0,21	0	4	
8	7	60°20.110'N	005°11.515'E	0,9	161,1°	10,0	0,04	0,21	0	5	
9	8	60°19.316'N	005°12.065'E	2,3	187,5°	10,0	0,04	0,21	0	14	
10	9	60°17.035'N	005°11.461'E	1,6	220,1°	10,0	0,04	0,21	0	9	
11	10	60°15.842'N	005°09.437'E	1,4	183,0°	10,0	0,04	0,20	0	8	
12	11	60°14.435'N	005°09.287'E	1,9	153,0°	10,0	0,04	0,21	0	11	
13	12	60°12.761'N	005°11.007'E	4,9	142,8°	10,0	0,21	0,21	0	29	Be awere of crossing ferries between WP 12 and 13.
14	13	60°08.862'N	005°16.957'E	4,0	159,0°	10,0	0,15	0,21	0	24	
15	14	60°05.154'N	005°19.805'E	3,9	180,2°	10,0	0,18	0,21	0	23	
16	15	60°01.278'N	005°19.775'E	2,5	157,4°	10,0	0,14	0,21	0	15	
17	16	59°58.923'N	005°21.737'E	5,6	130,3°	10,0	0,14	0,21	0	34	
18	17	59°55.279'N	005°30.294'E	2,3	156,2°	10,0	0,04	0,21	0	14	
19	18	59°53.154'N	005°32.166'E	6,5	170,4°	10,0	0,04	0,21	0	39	
20	19	59°46.687'N	005°34.346'E	10,9	223,5°	10,0	0,17	0,21	0	66	
21	20	59°38.816'N	005°19.559'E	7,3	210,2°	10,0	0,14	0,21	0	44	
22	21	59°32.489'N	005°12.295'E	6,7	173,1°	10,0	0,10	0,21	0	40	
23	22	59°25.908'N	005°13.858'E	0,4	188,2°	10,0	0,05	0,21	0	2	
24	23	59°25.518'N	005°13.747'E	0,6	160,1°	10,0	0,04	0,21	0	4	
25	24	59°24.958'N	005°14.146'E	0,5	136,5°	10,0	0,05	0,21	0	3	
26	25	59°24.621'N	005°14.775'E	1,0	132,7°	10,0	0,04	0,21	0	6	
27	26	59°23.924'N	005°16.260'E	1,1	145,2°	10,0	0,04	0,21	0	7	
28	27	59°22.984'N	005°17.542'E	0,7	166,2°	10,0	0,04	0,21	0	4	
29	28	59°22.363'N	005°17.841'E	0,4	180,6°	10,0	0,04	0,21	0	2	
30	29	59°21.936'N	005°17.832'E	0,8	145,5°	10,0	0,05	0,21	0	5	
31	30	59°21.259'N	005°18.746'E	0,5	182,7°	10,0	0,05	0,21	0	3	
32	31	59°20.791'N	005°18.703'E	0,8	158,3°	10,0	0,05	0,21	0	5	
33	32	59°19.923'N	005°19.382'E	0,3	242,9°	10,0	0,04	0,21	0	2	
34	33	59°19.771'N	005°18.799'E	0,5	296,8°	10,0	0,04	0,21	0	3	
35	34	59°20.021'N	005°17.828'E	0,3	349,1°	10,0	0,04	0,21	0	2	
36	35	59°20.224'N	005°17.751'E								
37											
38	Name	From	To	Owner	Tags	Date	Length(NM)	WPs			
39	Bergen - Husoy					12.11.2022	78.03 NM				

Figure 26 – ECDIS Route Planing File Format Example (.csv file)

Uploading the Route

To upload the route planning file, the user must use the ***Drag and Drop or Click to Choose a Trip Planning File*** button located at the top right of the map. When the file is uploaded correctly and loads successfully into the platform, the route, the legend, and a time control will be displayed on the map. A confirmation message will appear indicating successful file processing.

Since the ECDIS file does not provide the trip's starting hour, users must input this information. This input field is visible on the map, located below the upload button. By default, the starting hour is set to 8:00 A.M., but users can adjust it to reflect the actual departure time.

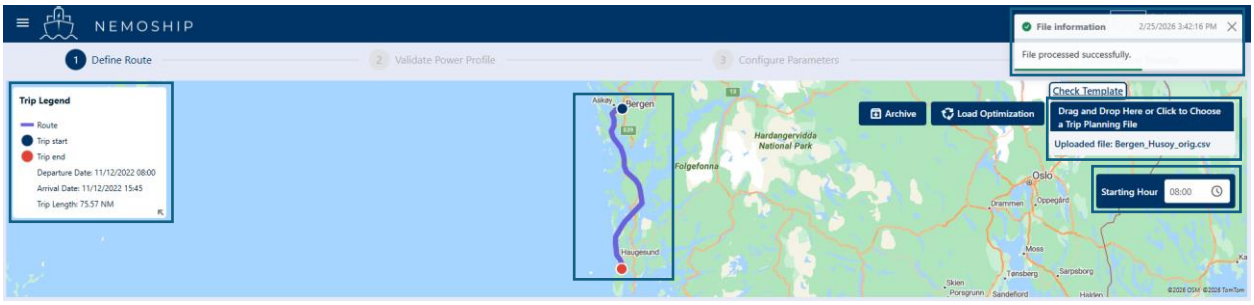

Figure 27 – Upload ECDIS Route Planning File in .csv format

If the file format is invalid, an error message will alert the user, and progression to the next step will not be possible. Moreover, a popup window will show all the waypoints that have missing values or values that are not within the accepted range.

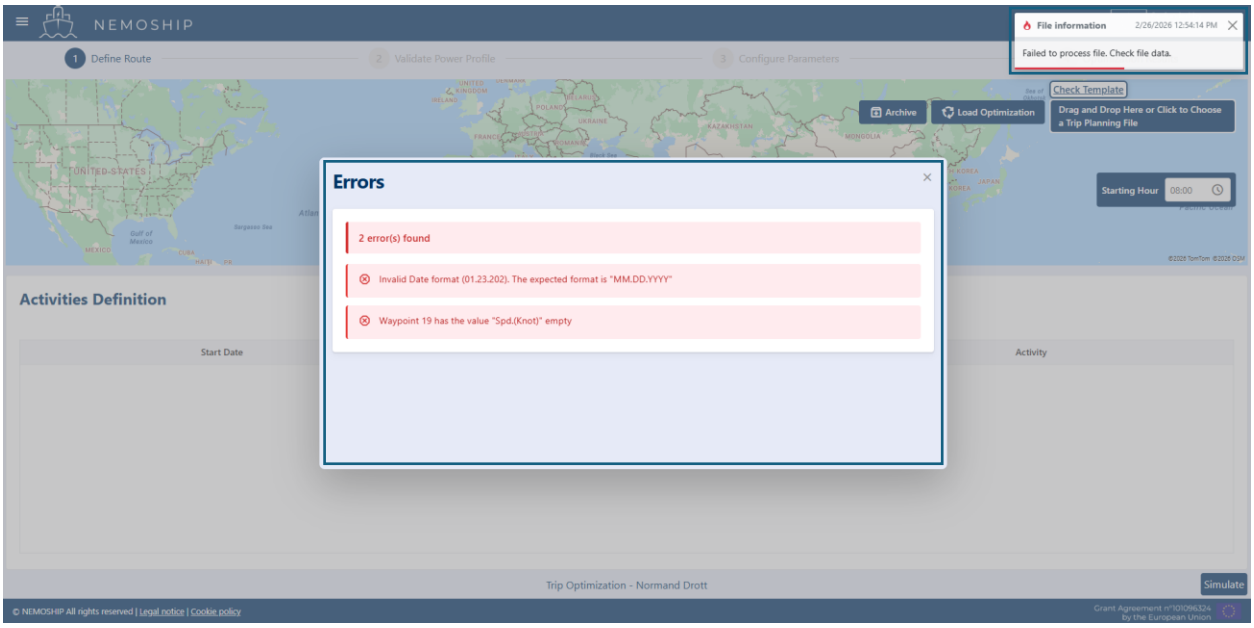

Figure 28 – Error Message on File Uploading

ECDIS File Template

Should the user encounter an invalid file, they can simply click the **Check Template** button.

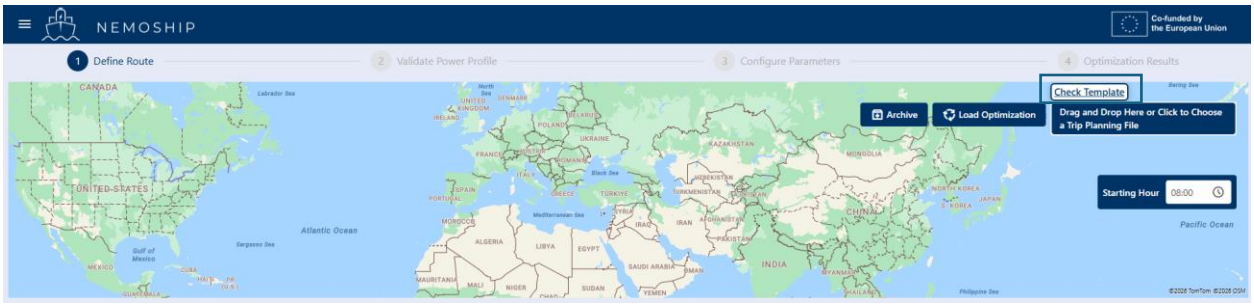

Figure 29 - Check Template Button

This action will open a new window designed to clearly illustrate the required file format. First, an image displaying a valid file format is presented. Second, the user has the option to download a valid template file, which can serve as a helpful guideline for updating their own file. Finally, detailed specifications are provided. These specifications include all mandatory fields, their respective valid intervals, and other crucial details regarding separators, number formats, and date formats.

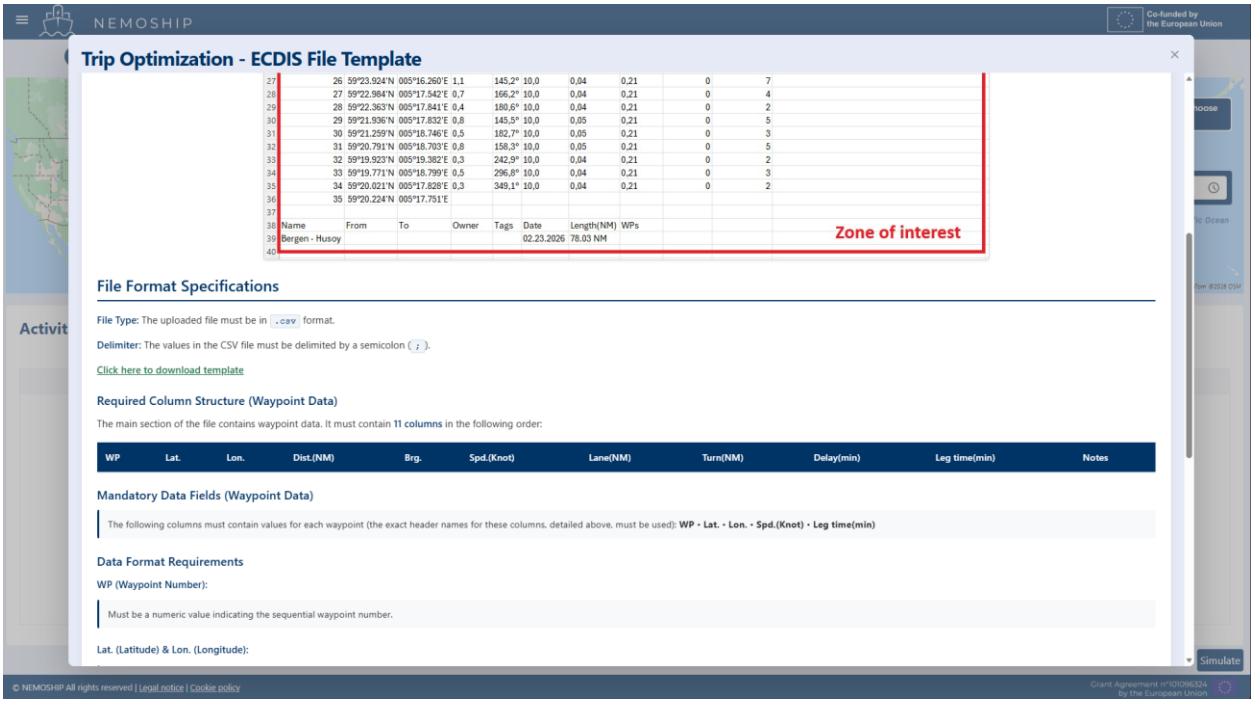

Figure 30 - Check Template Page

Defining Activities

After successful file upload, two additional buttons become available: **Add Entry** and **Remove Last Entry**. These buttons allow users to define different activities along the imported route. The possible activities users can add to their trip plan are:

- **Port**
- **Standby**
- **Dynamic Positioning (DP)**

Any intervals not specifically defined as one of the above activities will automatically be considered **Transit**. If no activities are added at all, the entire trip will be considered **Transit** by default.

When the **Add Entry** button is pressed, a new entry appears in the table. To define an activity interval, three variables must be specified:

- ***Start Date and Hour***- Beginning of the activity period
- ***End Date and Hour*** - End of the activity period
- ***Activity*** - Select from the following options:
  - *Port*
  - *Standby*
  - *DP*

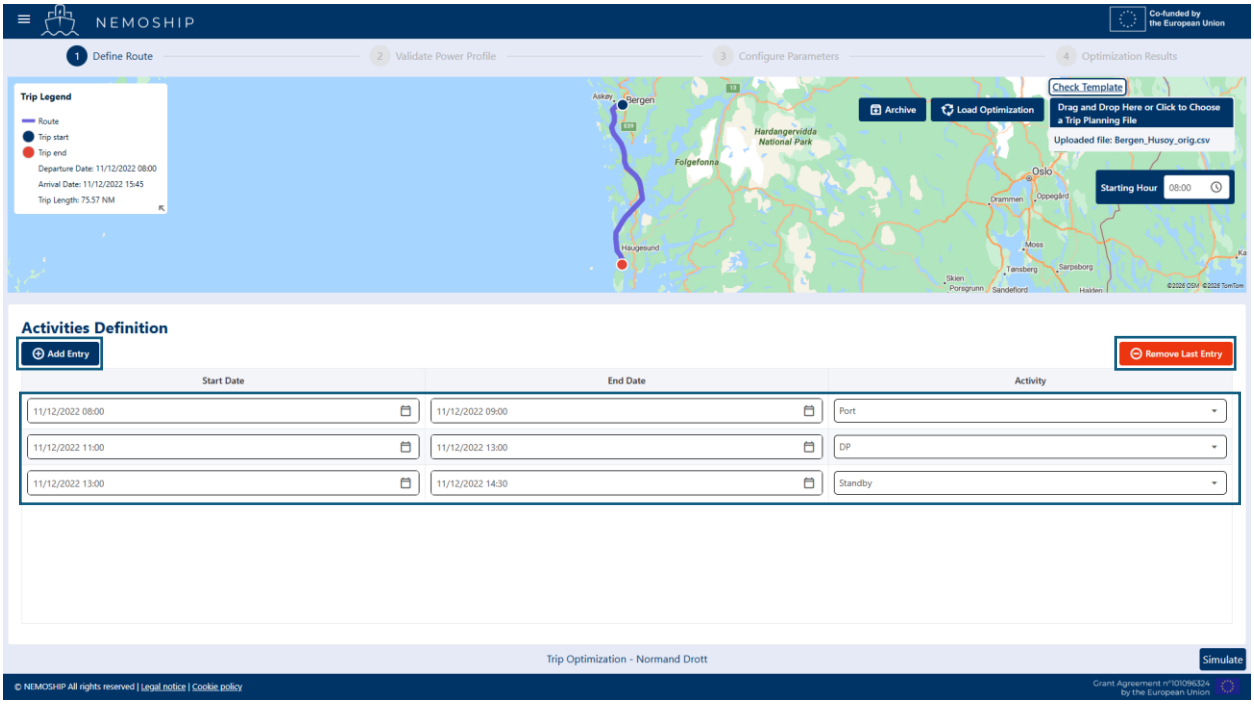

Figure 31 - Activities Definition

The **Remove Last Entry** button removes the most recent table row.

Multiple rows can be added as needed, but the following requirements must be followed:

- Start Date must always be earlier than End Date for each row
- Start Date of each new entry must be after the previous entry's End Date

If these conditions are not met, error messages will appear in the table or at the top right of the page when the Simulate button is pressed.

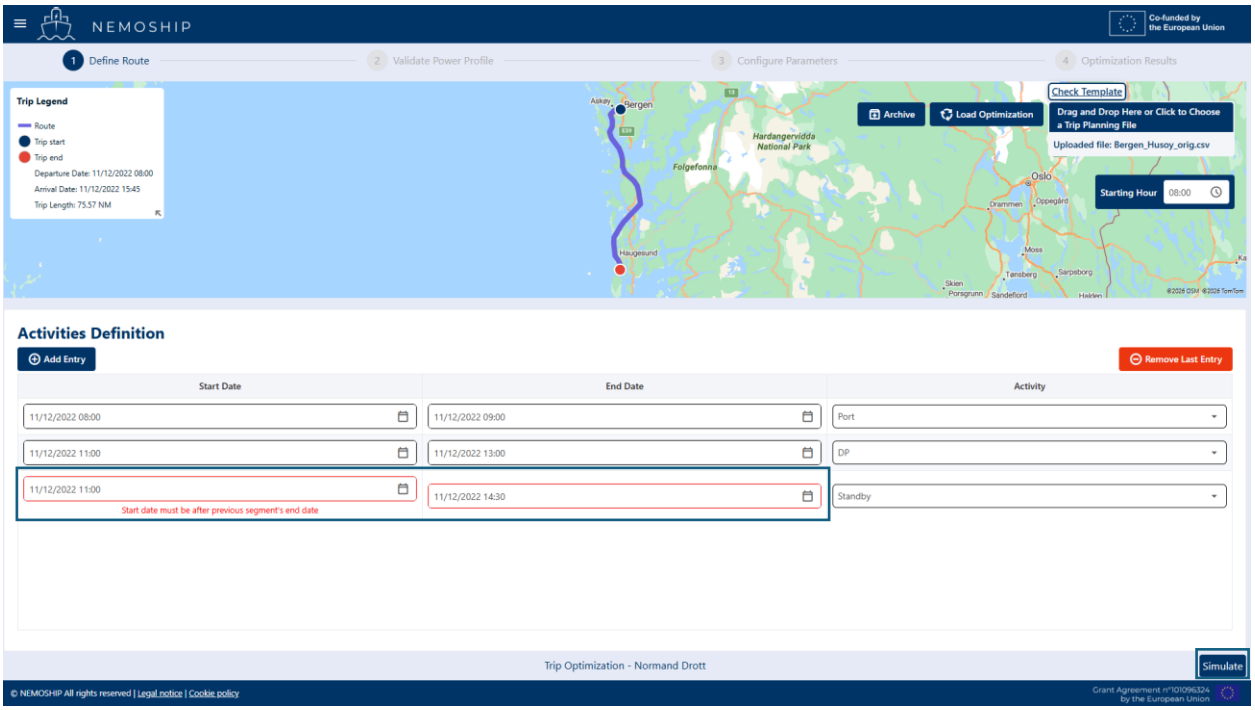

Figure 32 – Activity Date Validations

To proceed to the next step, press the **Simulate** button located at the bottom right of the screen.

Simulation Process

When the **Simulate** button is pressed, two main processes occur. First, the platform retrieves weather conditions for the imported route using an external weather provider (Open Meteo) and associates these conditions to each waypoint. Second, the platform uses a digital model to predict the power profile required by the vessel for the specified activities.

During these processes, a loading page displays all steps in detail and shows the current execution point of the background processes.

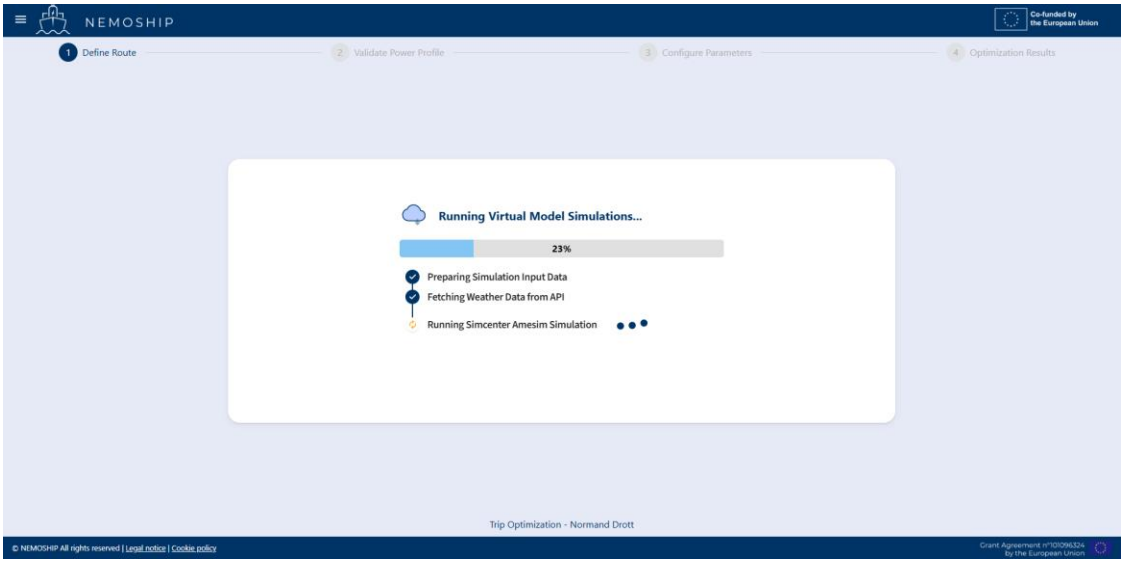

Figure 33 – Simulation Status

4.3.2 Step 2: Validate Power Profile

Once the power profile prediction is complete, the results will be displayed on a plot in the second step of the module. This step serves as a **validation point**, where the power profile can be analyzed to determine whether to proceed with the optimization process.

Should any anomalies be observed, it is recommended to review both the defined activities and the imported route file. The details within the route file, such as waypoint coordinates (latitude and longitude) and the intended vessel speed between waypoints, significantly impact the simulation.

To enhance the visualization of the power profile, each activity type is highlighted with a distinct color on the plot, making them easy to review:

- **Port:** Grey
- **Dynamic Positioning (DP):** Purple
- **Standby:** Orange
- **Transit:** White

If the power profile appears appropriate, navigation to the next step can be achieved by clicking the **"Next"** button or by selecting the **"Configure Parameters"** step from the top navigation.

Figure 34 – Simulated Shaft Power Validation

4.3.3 Step 3: Configure Parameters

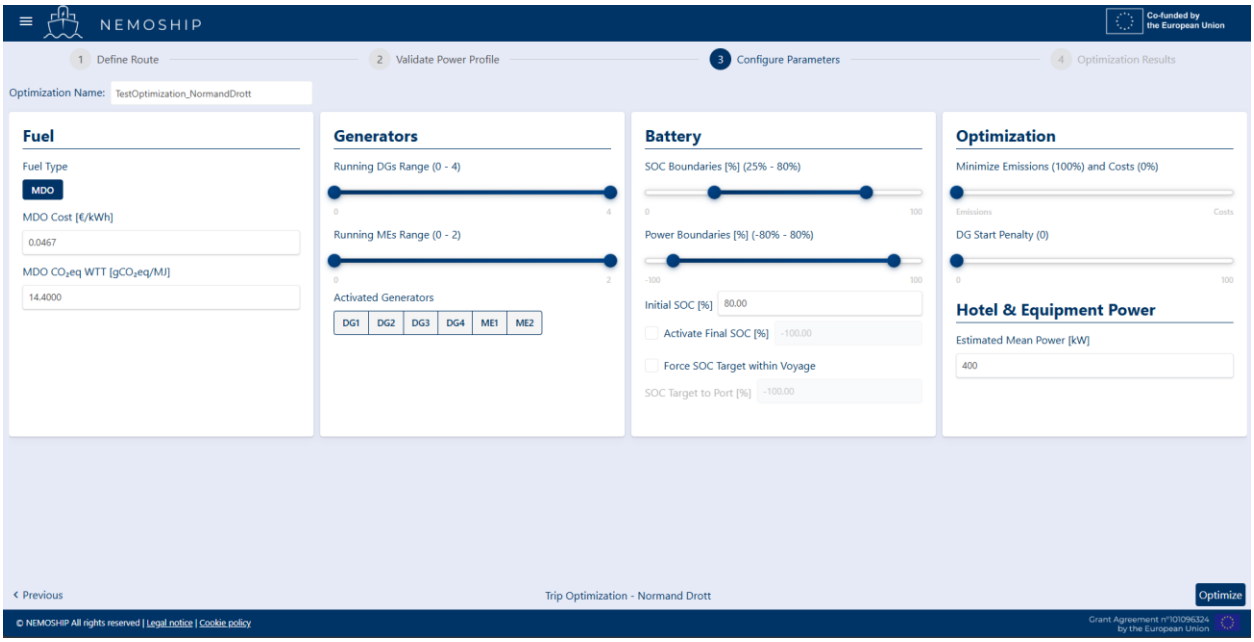

Figure 35 – Optimization Parameters

The third step consists of a set of parameters that can be configured before performing the optimization. All parameters have default values but can be changed based on user preferences. The parameters are divided into 5 categories:

Fuel

- **Fuel Type**: MDO *(default: MDO)*
- **MDO Cost [€/kWh]**: Cost per kilowatt-hour for Marine Diesel Oil *(default: 0.0467)*
- **MDO CO_2eq WTT [gCO_2eq/MJ]**: Well-to-tank CO_2 equivalent emissions for MDO *(default: 14.4000)*

Generators

- **Running DGs Range**: Range for diesel generators operation *(default: 0 – 4)*
- **Running MEs Range**: Range for main engines operation *(default: 0 – 2)*
- **Activated Generators**: Selection of active generators/engines *(default: no generators activated)*

Battery

- **SOC Boundaries [%]**: State of Charge operational boundaries for the battery system *(default: 25% - 80%)*
- **Power Boundaries [%]**: Power limits for battery charging and discharging *(default: -80% - 80%)*
- **Initial SOC [%]**: Starting State of Charge level *(default: 80%)*
- **Activate Final SOC [%]**: Target State of Charge at voyage completion *(default: 20%)*
- **Force SOC Target within Voyage – SOC Target to Port [%]**: Target State of Charge at port (*default: 80%)*

Optimization

- **Minimize Emissions and Costs:** Weighting factor for optimization objectives *(default: minimize emissions)*
- **DG Start Penalty**: Penalty applied for diesel generator startup events *(default: 0)*

Hotel & Equipment Power

- **Estimated Mean Power [kW]**: Average hotel and equipment power consumption *(default: 400 kW)*

Once the optimization parameters have been defined, the next step is pressing the **Optimize** button. A loading screen will appear while the optimization runs in the background. Depending on the length of the trip and the configured parameters, the optimization process may take anywhere from 1-2 minutes to 10-30 minutes to complete.

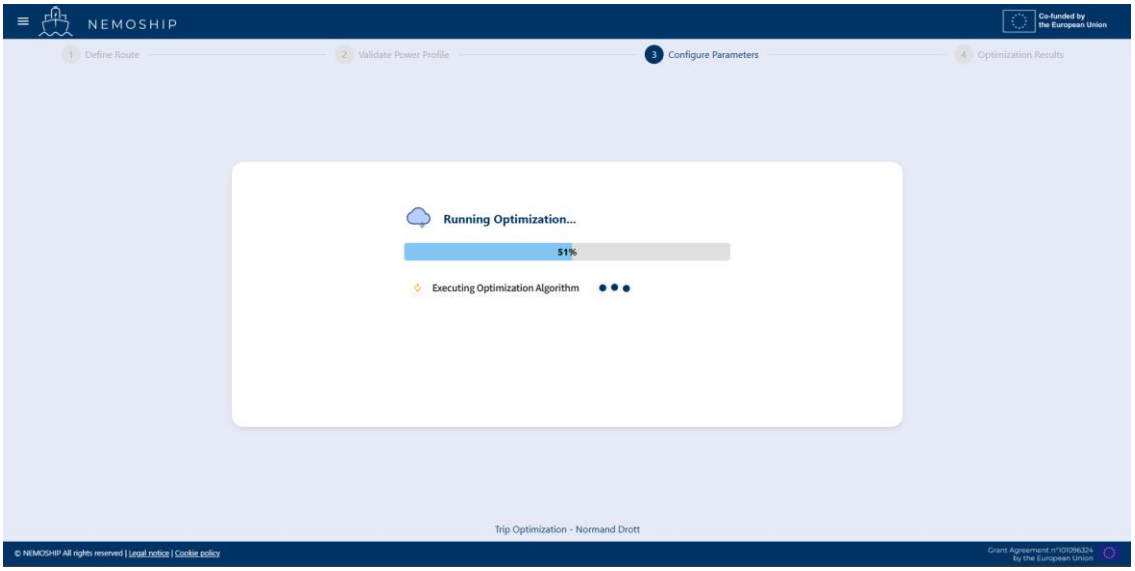

Figure 36 – Optimization Running

4.3.4 Step 4: Optimization Results

After the optimization algorithm completes its run, users are automatically redirected to the 4th step where optimization results are available.

Key Performance Indicators

On the top left corner, multiple key performance indicators are displayed, describing costs, emissions, and other relevant information for the configured trip and parameters. The available metrics are:

Environmental Metrics:

- **Total CO_2eq emissions [kgCO_2eq]**: Total carbon dioxide equivalent emissions for the entire trip

Cost and Fuel Consumption:

- **Total fuels costs [euros]**: Cost of the fuel consumed during the trip
- **Mass of MDO consumed [t]**: Total Marine Diesel Oil consumption

Efficiency Metrics:

- **Global efficiency [-]**: Overall system efficiency across all power sources
- **BESS efficiency [-]**: Battery Energy Storage System efficiency
- **DGs efficiency [-]**: Diesel Generators efficiency
- **MEs efficiency [-]**: Main Engines efficiency

Operational Statistics

- **BESS equivalent cycles [-]**: Number of complete battery charge/discharge cycles
- **Number of DGs running hours [h]**: Total operating time for Diesel Generators

- **Number of MEs running hours [h]**: Total operating time for Main Engines
- **Number of DGs starts [-]**: Total startup events for Diesel Generators
- **Number of MEs starts [-]**: Total startup events for Main Engines

These indicators provide a comprehensive overview of the optimization results, allowing users to evaluate the performance of the recommended power management strategy across economic, environmental, and operational dimensions.

Below the KPI table, there is a **Parameters** button that allows users to review the values of all parameters configured in *Step 3: Configure Parameters* page. This feature provides a convenient way to verify the settings used for the current optimization run without navigating back to the configuration step.

When viewing the parameters summary, all parameter values from the five categories (Fuel, Generators, Battery, Optimization, and Hotel & Equipment Power) are displayed. Parameters that were modified from their default values are highlighted with blue underlined text, providing visual indication to help users quickly identify which settings they customized for the current optimization. Default parameter values remain in standard text format.

Figure 37 – Optimization Results – KPIs and Parameters

Map

On the right side of this table there is a map present in which the input trip can be seen. Moreover, information such as departure date, arrival date and trip length in nautical are present in the legend.

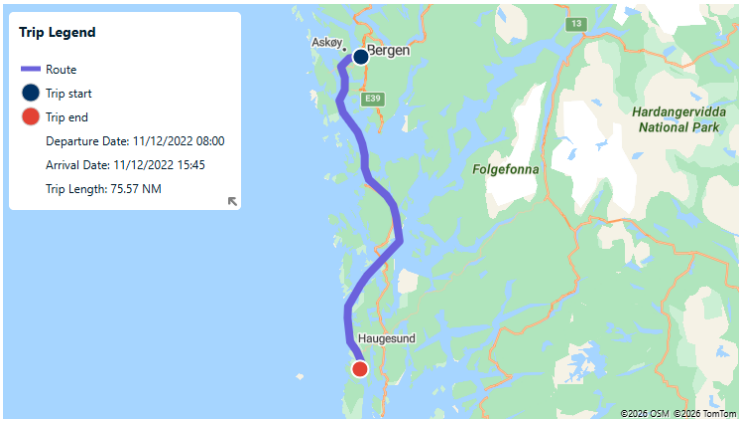

Figure 38 – Trip Displayed on Map

PMS Advices

The Power Management System (PMS) Advices table displays critical operational recommendations generated by the optimization algorithm. This section presents key battery management parameters that have been optimized for the specific trip conditions. It is important to note that these recommendations may sometimes be unavailable, depending on the results obtained from the optimization algorithm.

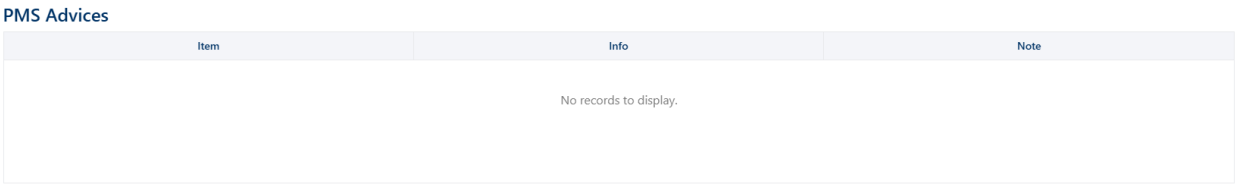

Figure 39 – Optimization Results – PMS Advices

Global Power Distribution Analysis

Below the advisories, a comprehensive **Global Power Distribution Analysis chart** visualizes the optimized power allocation strategy throughout the entire trip timeline. The chart displays power output in kilowatts on the vertical axis against the trip timeline on the horizontal axis. Multiple colored bars represent different power sources including DG1 through DG4 power outputs, ME1 and ME2 power outputs, battery discharge power, battery charge power, and the overall output power demand line. This visualization allows maritime operators to understand how the optimization algorithm distributes power generation across different sources at various points during the voyage, showing when batteries should charge or discharge and which generators or main engines should operate to achieve optimal efficiency, cost, and emissions performance.

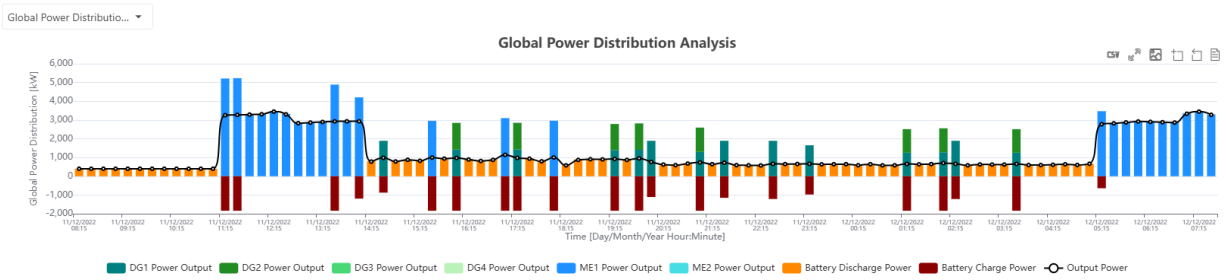

Figure 40 – Optimization Results – Global Power Distribution Analysis

Shaft Power Distribution Analysis

Following the Global Power Distribution Analysis, the **Shaft Power Distribution Analysis chart** provides a detailed visualization of how power is distributed to the vessel's propulsion system over the trip timeline. This view can be selected from the dropdown menu located at the top-left of the chart interface. The chart displays power in kilowatts on the vertical axis, with the trip timeline on the horizontal axis. Various colored bars indicate the contributions from different power sources to the shaft, including Power Take-in 1 (Shaft) and Power Take-in 2 (Shaft) representing power supplied to the shaft from specific sources, Shaft Generator 1 and Shaft Generator 2 illustrating power generated by shaft-driven generators, and ME1 Power Output and ME2 Power Output showing the power directly produced by the main engines. The Propulsion Power line, marked with black circles, represents the total power demand for propulsion. This visualization enables maritime operators to understand the real-time allocation of power to the propulsion system, showing how different engines, generators, and power take-ins contribute to meeting the vessel's propulsion needs throughout the trip. It highlights the dynamic interplay of these components in maintaining efficient and optimized propulsion.

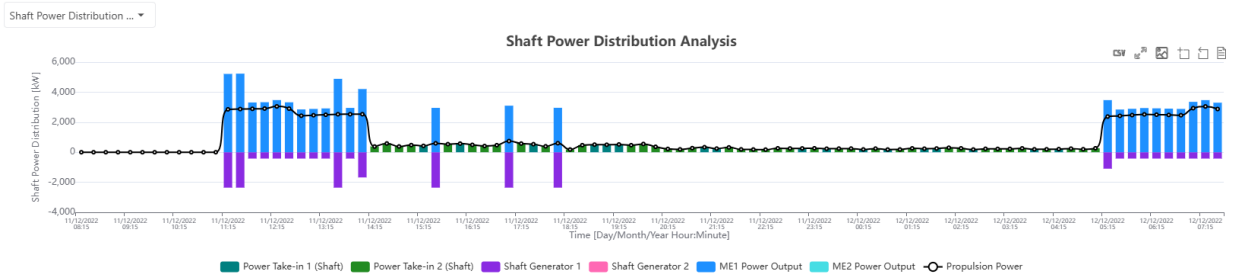

Figure 41 - Optimization Results – Shaft Power Distribution Analysis

Electrical Bus Power Distribution Analysis

The **Electrical Bus Power Distribution Analysis chart** offers a comprehensive view of how electrical power is generated and consumed on the vessel throughout the trip timeline. This specific analysis can be accessed by selecting it from the dropdown menu located at the top-left of the chart interface. The chart illustrates power in kilowatts on the vertical axis, with the trip timeline on the

horizontal axis. Various colored bars represent the contributions of different electrical power sources and demands, including DG1 through DG4 Power Output from diesel generators, Shaft Generator 1 (Electrical) and Shaft Generator 2 (Electrical) indicating power generated by shaft-driven generators, Power Take-in 1 (Electrical) and Power Take-in 2 (Electrical) showing electrical power supplied from external or internal sources, Battery Discharge Power, and Battery Charge Power. The overall electrical demand line, marked with black circles, represents the total power required by the electrical bus. This visualization allows maritime operators to understand the dynamic balance of electrical power generation and consumption, identifying when different generators are active, how shaft generators contribute, and the role of battery discharge in meeting the vessel's electrical needs for optimal efficiency and reliability.

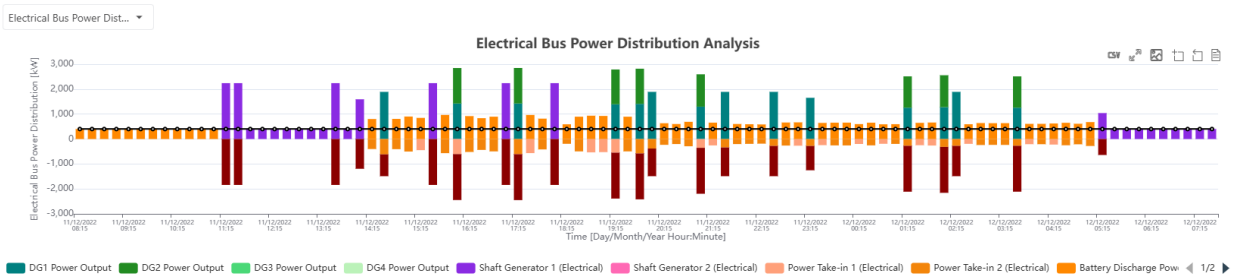

Figure 42 - Optimization Results – Electrical Bus Power Distribution Analysis

Other plots

In the bottom section of the results page, two additional visualization areas provide detailed analysis of the optimization outcomes. The left side features a dropdown menu with four selectable items that dynamically change the plot content based on the user's selection, while the right side offers a choice between two items that similarly update the displayed plot according to the selection.

Figure 43 - Optimization Results - Side-by-side Plots

Left Side Plot Selection

The dropdown menu on the left allows users to analyze six different aspects of the power management strategy.

The **Active DGs and MEs plot** shows the number of generators that should be operational at each 15-minute interval throughout the trip, with blue bars representing the count of main engines and a green line indicating the number of diesel generators that should be active.

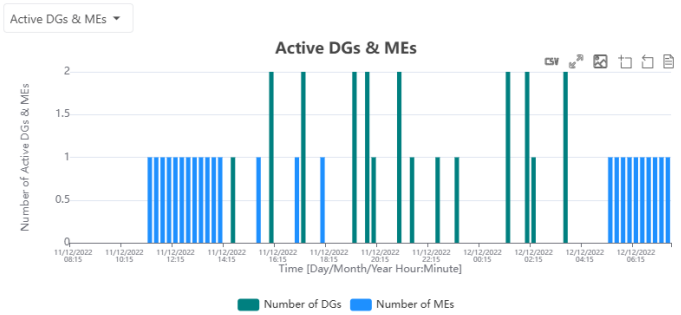

Figure 44 – Optimization Results – Active DGs

The **DGs and MEs Power plot** displays the actual power output generated by both diesel generators and main engines over time, maintaining the same 15-minute timestep resolution.

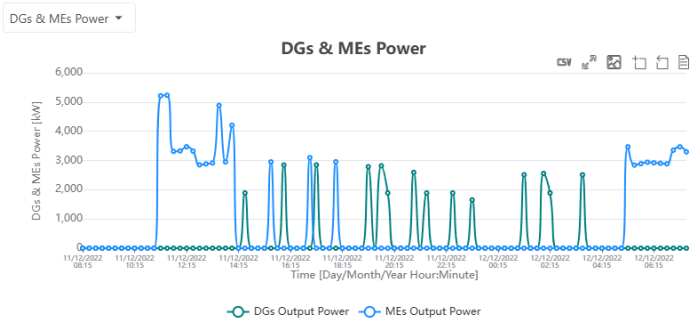

Figure 45 – Optimization Results – DGs and MEs Power

The **DGs and MEs Load plot** presents the individual load percentage for each of the four generators and two main engines, allowing operators to see how the optimization distributes workload across the available generating units.

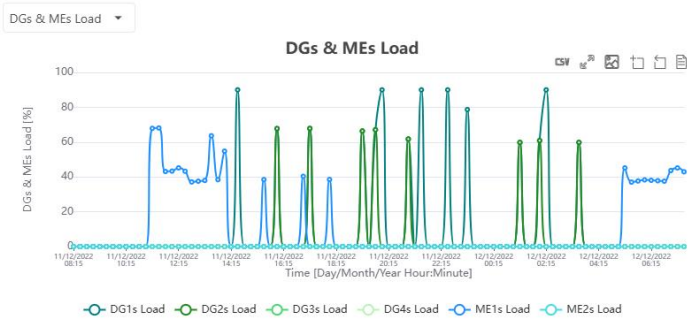

Figure 46 – Optimization Results – DGs and MEs Load

The **Battery SOC plot** illustrates the evolution of the battery's state of charge over time based on the configured parameters and optimization strategy.

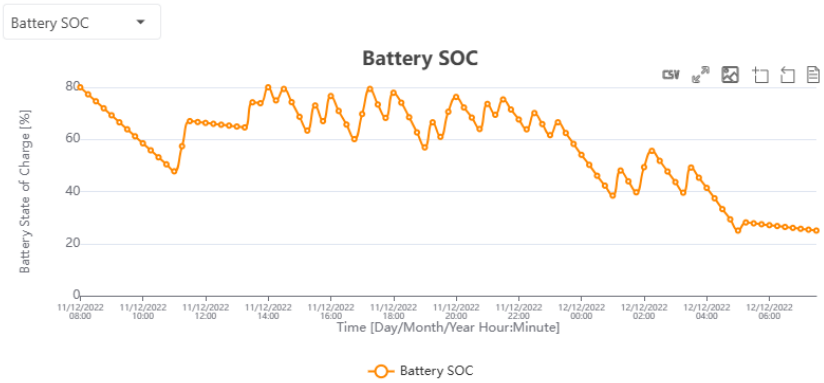

Figure 47 – Optimization Results – Battery SOC

The **PTI, SG and ME on Shaft chart** provides a concise overview of the power contributions from Main Engines (MEs Output Power), Power Take-Ins (PTIs Shaft Power), and Shaft Generators (SGs Electrical Power) directly on the vessel's shaft over the trip timeline.

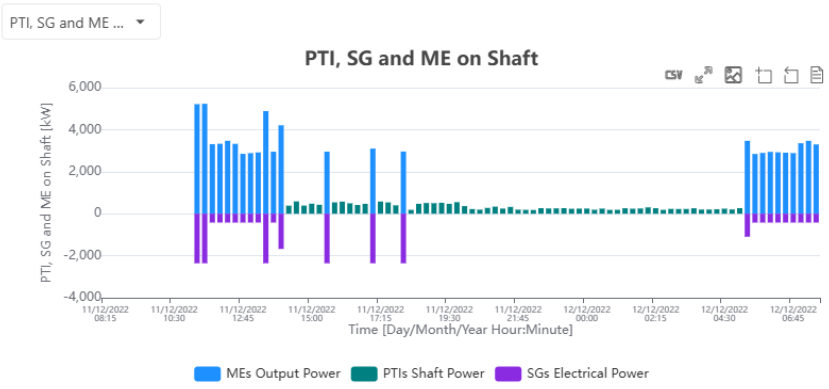

Figure 48 - Optimization Results - PTI, SG and ME on Shaft

The **PTI and SG on Grid chart** illustrates the electrical power exchange between Power Take-Ins (PTIs Electrical Power) and Shaft Generators (SGs Electrical Power) with the vessel's electrical grid over the trip timeline.

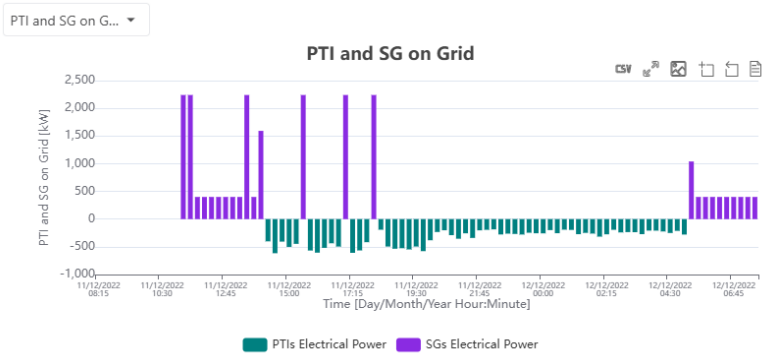

Figure 49 - Optimization Results - PTI and SG on Grid

Right Side KPI Visualization

The right side of the interface provides users with a choice between two critical performance metrics.

The **Emissions plot** tracks the evolution of CO_2 equivalent emissions and CO_2 equivalent methane emissions throughout the voyage, helping operators understand the environmental impact of the optimized power management strategy.

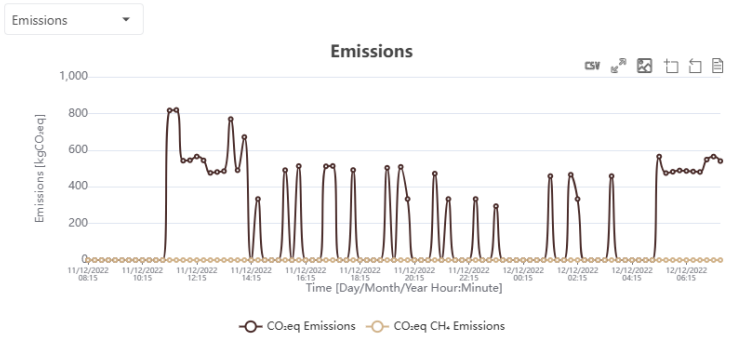

Figure 50 – Emissions

Alternatively, the **Fuel Consumption plot** displays the projected quantities of Marine Diesel Oil (MDO) that will be consumed during the trip, providing essential information for fuel planning and cost analysis.

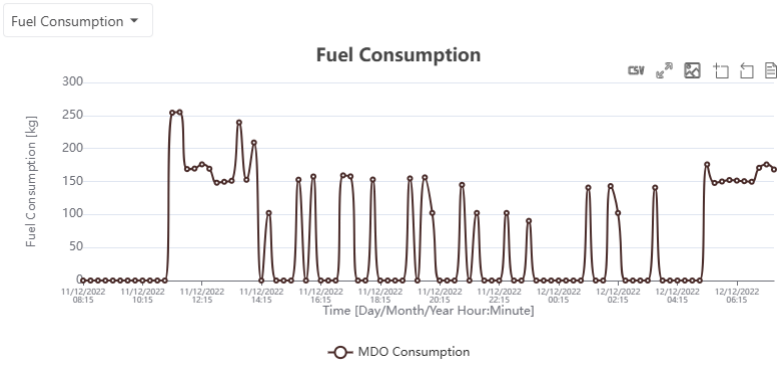

Figure 51 – Optimization Results – Fuel Consumption

4.3.5 Archive

On the first step of the Trip Optimization process, near the upload button, there is an Archive button that provides users with convenient access to their optimization history. This feature allows users to easily return to previous optimizations without having to repeat the entire four-step process from beginning to end.

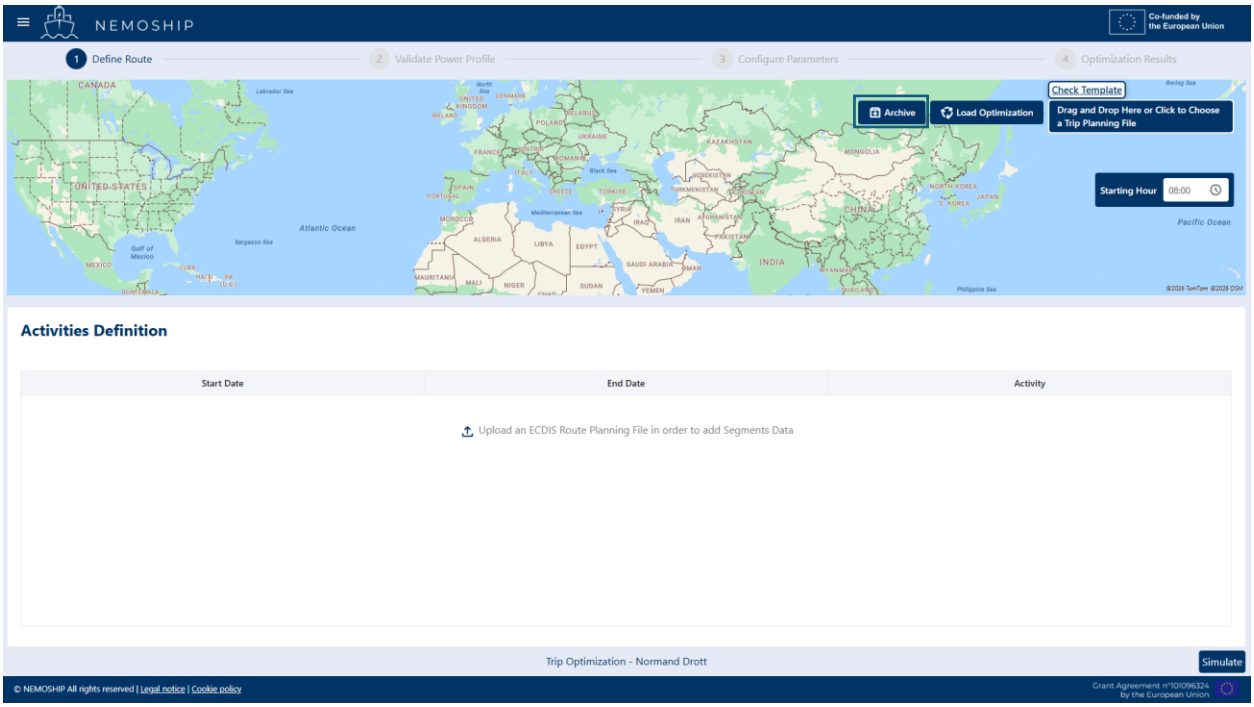

Figure 52 – Trip Optimization – Archive Button

The archive page contains a "Go Back to Trip Optimization" button at the top that redirects users directly to Step 1 of the Trip Optimization workflow. The main content area features a comprehensive

table on the left side with five distinct columns that organize the optimization history and a map on the right side.

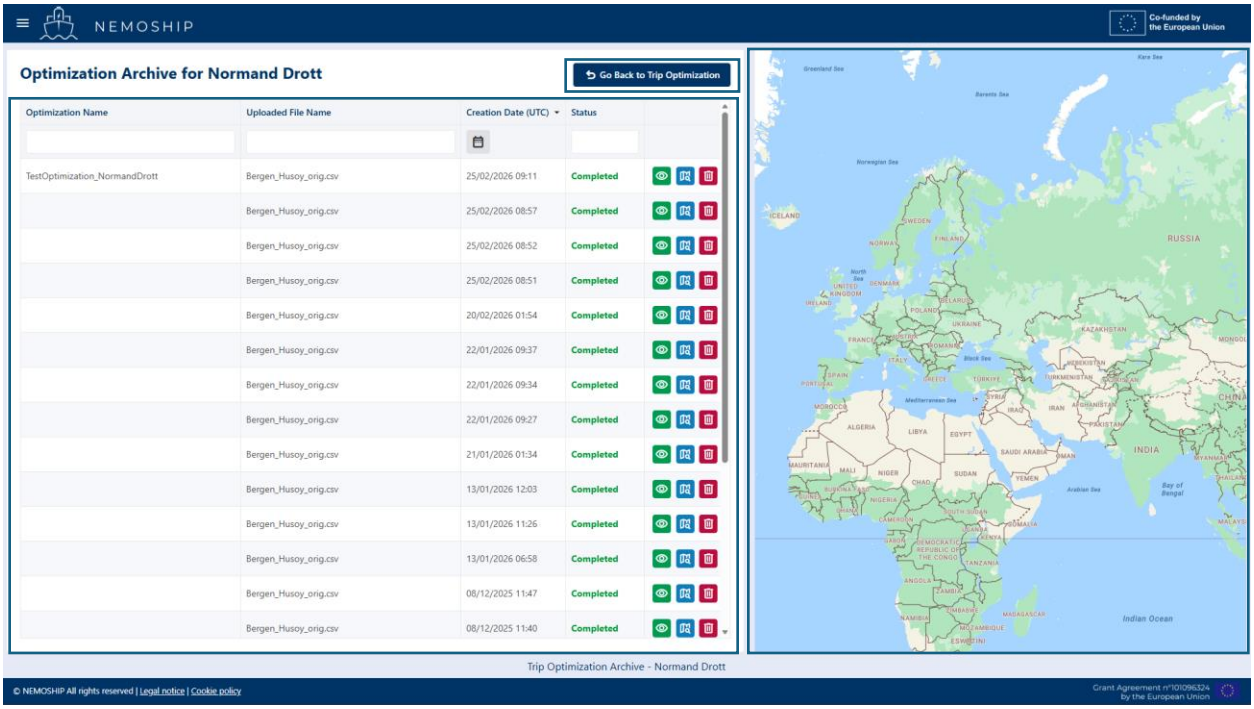

Figure 53 – Trip Optimization – Archive Window

Archive Table Columns

- The first column displays the name of the optimization (default name or the name set by the user in **Configure Parameters** step)
- The second column displays the name of the file that was used for importing the trip data on which the optimization was performed
- The third column shows the date when the optimization was executed, presented in UTC format
- The fourth column indicates the current status of each optimization process, which can display several states:
    - **Completed** for optimizations that finished successfully
    - **Failed** when errors occurred during the optimization process (such as conflicting constraints or infeasible solutions)
    - **Error** for issues related to digital platform processes
    - **In Progress** for optimization processes that are still running
- The fifth column contains three action buttons for each optimization entry
    - The first button opens a new window displaying the complete optimization results, which presents an identical interface to the Step 4 results page previously described

Figure 54 – Trip Optimization – Archive Results

- The second button visualizes the trip route on the map display on the right side

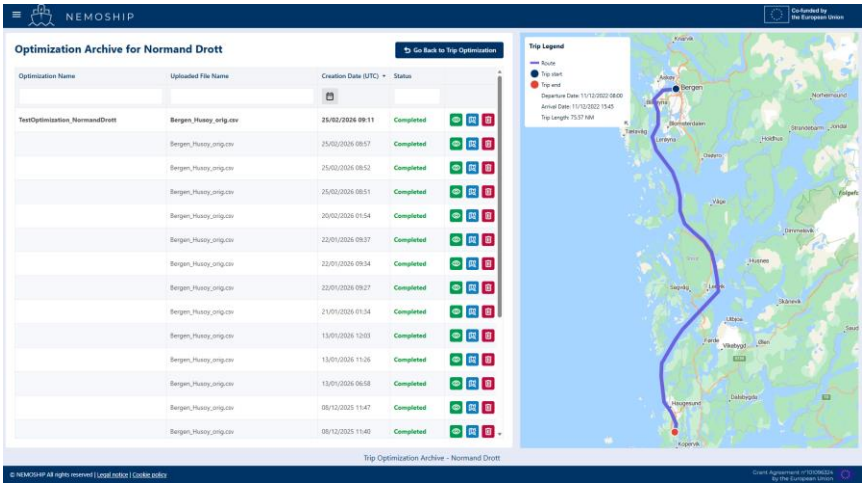

Figure 55 – Trip Optimization – Archive Trip Visualization

- The third button allows users to permanently delete the optimization results from their archive

4.3.6 Load Optimization

During the initial step of the Trip Optimization process, located near the **Archive** button, users will find the **Load Optimization** button. This feature allows users to retrieve a previously performed optimization and modify only its optimization parameters, eliminating the need to re-import the file, re-add activities, or re-run the simulation that generates the power profile. This provides a convenient method for adjusting optimization parameters, clicking **Optimize** again, and quickly reviewing the updated optimization results.

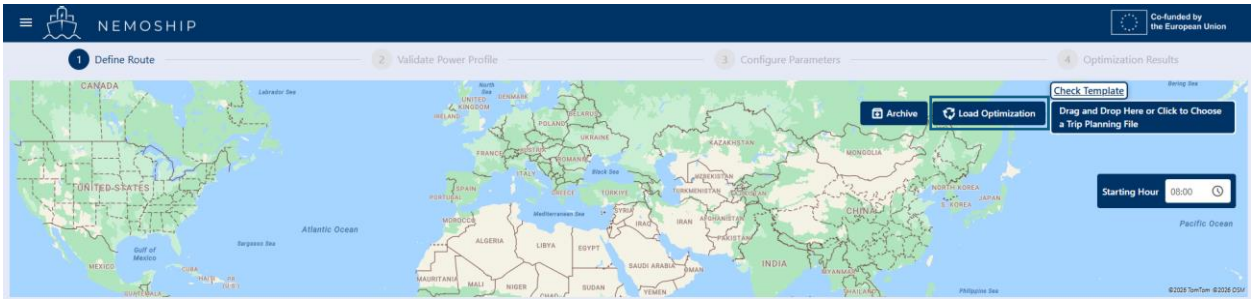

Figure 56 - Load Optimization Button

Upon clicking the **Load Optimization** button, the user is directed to a page displaying all their past optimizations (identical to those visible on the **Archive** page).

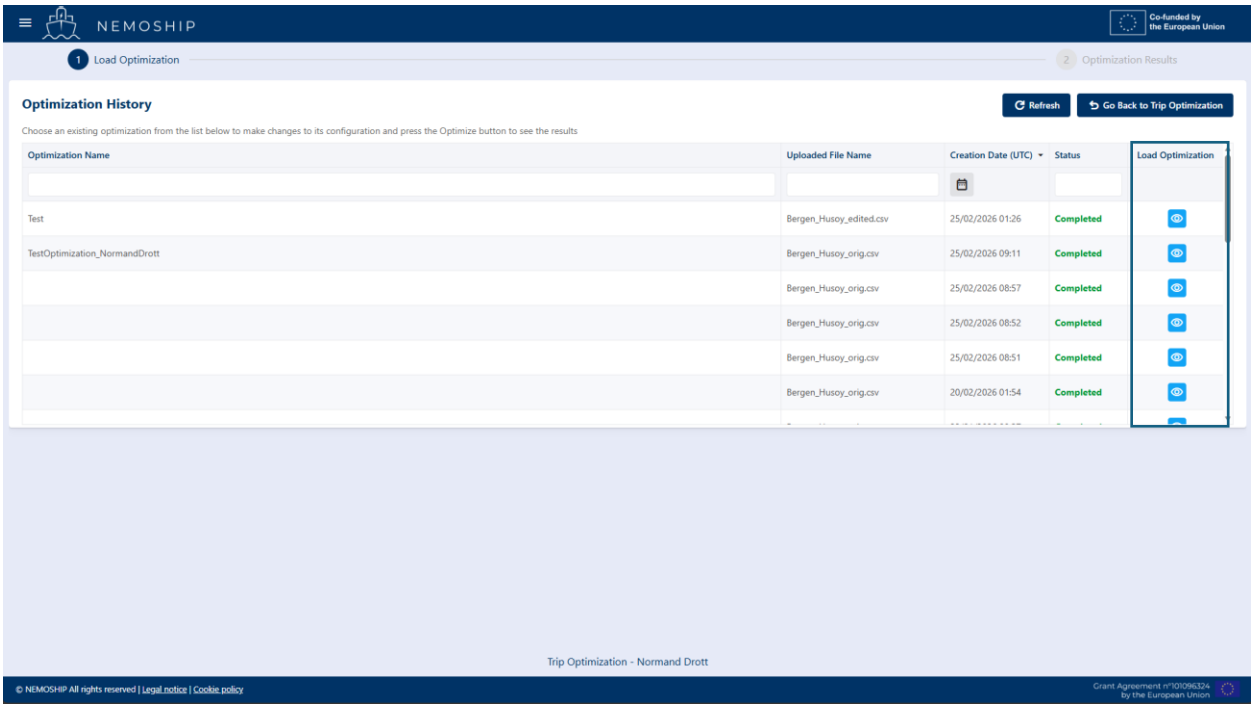

Figure 57 - Load Optimization View

To load a specific optimization, the user must click the **blue "eye" icon** located in the last column of the displayed table. This action will load the configurations of the selected optimization, enabling the user to visualize:

- The map with the trip route.
- The power profile generated by the simulation run (which considers waypoints, speed, weather conditions, and user-defined activities).

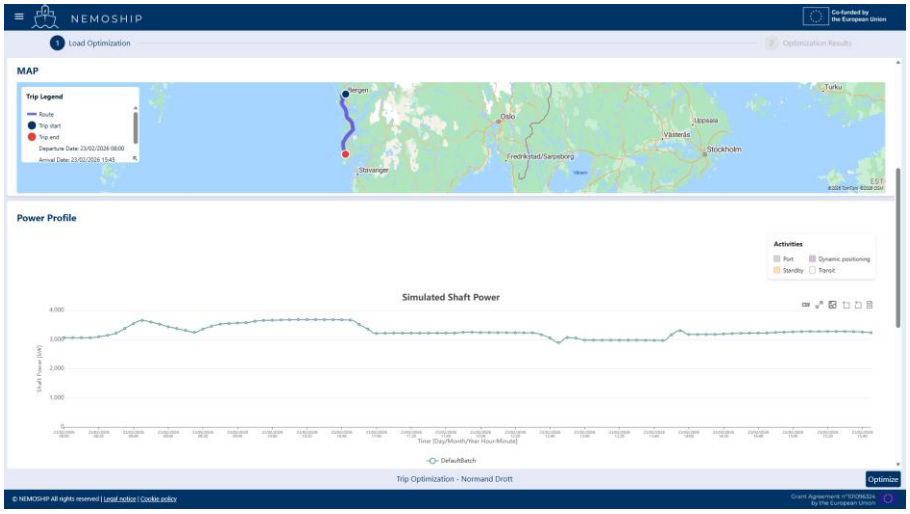

Figure 58 - Map and Power Profile Load

- The optimization parameters that were previously set.

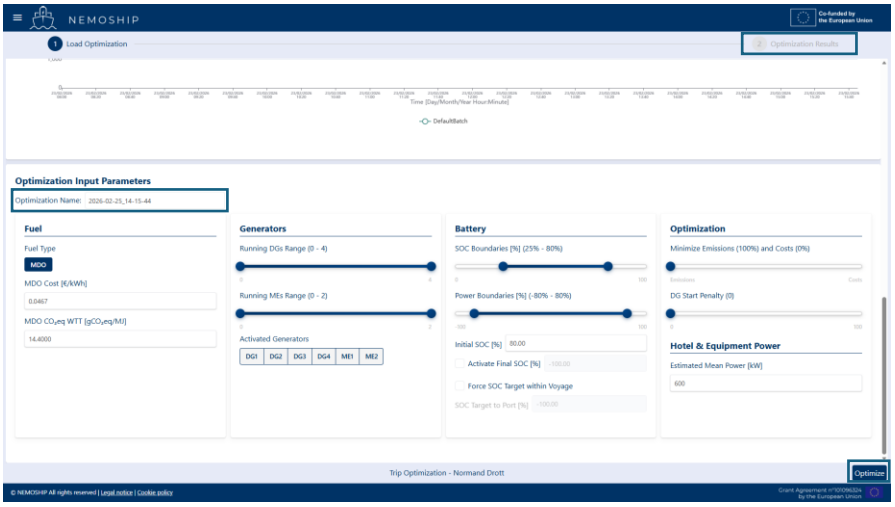

Figure 59 - Optimization Parameters Load

It's important to note that the *Optimization Name* will not be the one previously set. The platform is designed to create a new set of results under a new optimization name rather than overwriting existing ones. The user can then modify this name and various parameters and proceed by clicking the **Optimize** button. Once the optimization is complete, the results will be displayed in the same manner as presented within this module's workflow. In this specific case, the user will be redirected to the second step (**Optimization Results**) where the results will be visible.

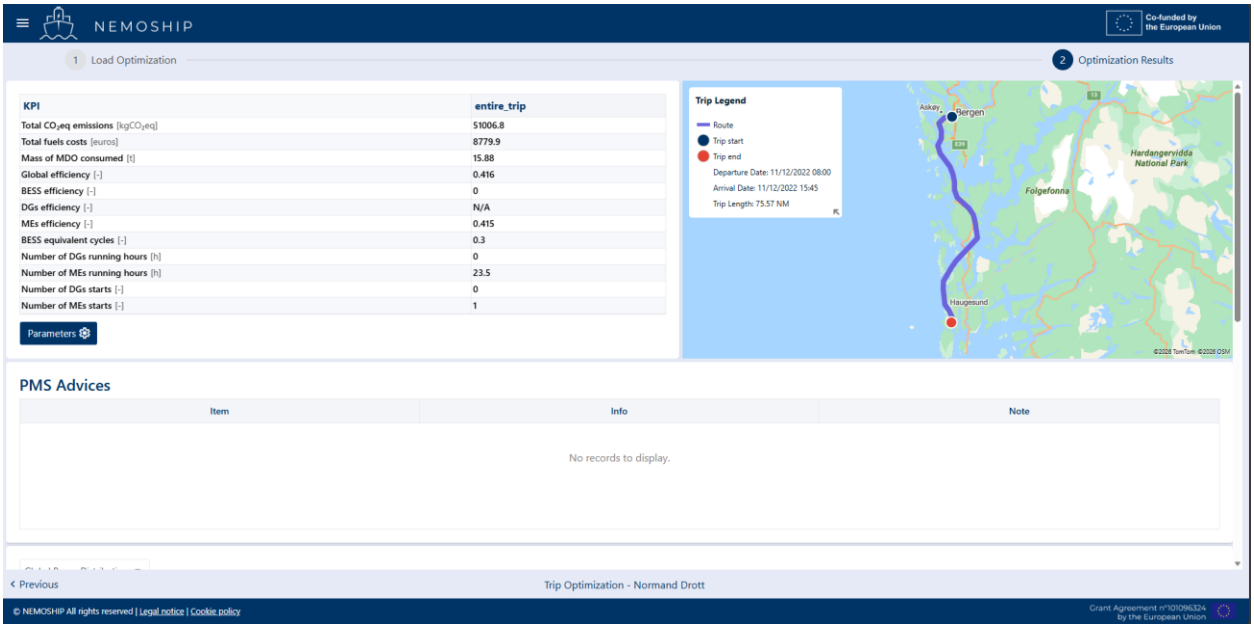

Figure 60 - Results of a Loaded Optimization with Parameters Changes

At the top of this page, two additional buttons are available:

- **Refresh:** This button is used to update the statuses of the optimizations. Only *Completed* optimizations can be loaded. Therefore, if a user has *In Progress* optimizations, they can click **Refresh** to check when an optimization has finished, and only then proceed to load it for further modifications. Attempting to load an *In Progress* optimization will trigger a warning message, explaining that only completed optimizations are eligible for loading.

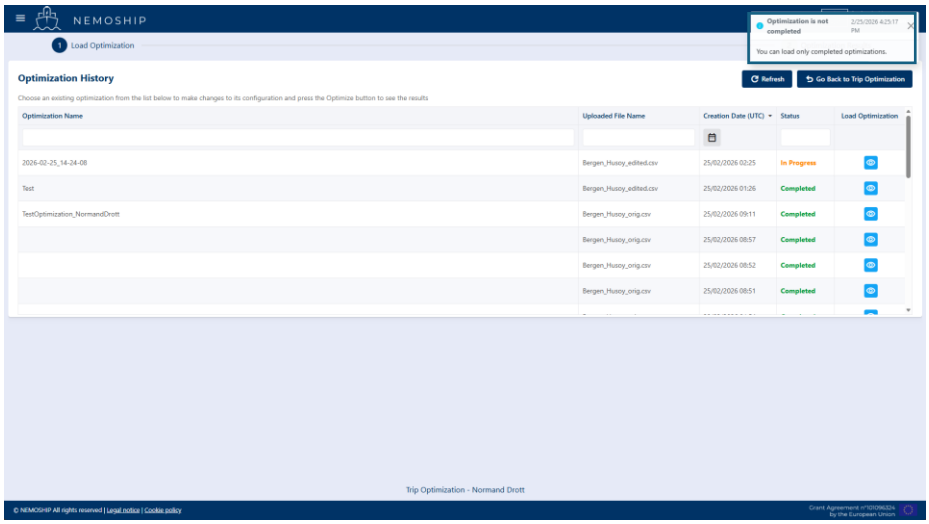

Figure 61 - Warning Message when Loading "In Progress" Optimizations

- **Go Back to Trip Optimization:** Clicking this button redirects the user to the first step (Define Route) of the Trip Optimization module.

5 Conclusion

The NEMOSHIP Digital Platform provides vessel operators with powerful tools to monitor, analyze, and optimize Battery Energy Storage System (BESS) performance. Throughout this manual, we have explored the platform's key features, from real-time monitoring and interactive dashboards to detailed voyage analysis and performance reporting. By using these tools effectively, operators can achieve significant fuel savings, reduce greenhouse gas emissions, and improve overall operational efficiency.

The platform transforms complex operational data into clear, actionable insights. Users can track critical metrics such as State of Charge, power flow, and operational modes in real-time, while also accessing historical data to identify trends and optimization opportunities. The interactive map features allow operators to visualize voyage routes and correlate geographical factors with performance data, providing a complete picture of vessel operations.

Environmental and economic benefits go hand in hand with the NEMOSHIP platform. Reduced diesel generator runtime leads to lower fuel consumption and maintenance costs, while simultaneously decreasing emissions and methane slip. The platform's comprehensive reporting capabilities support regulatory compliance with EU GHG and IMO CII requirements, helping vessels meet increasingly stringent environmental standards. Every optimization identified and implemented contributes to both cost savings and environmental stewardship.

To maximize the value of the NEMOSHIP Digital Platform, the recommendation is to establish regular monitoring routines, analyzing voyage data systematically, and sharing insights across operational teams. Use the platform's comparative analysis features to identify best practices and interpret historical data to plan future voyages more efficiently.

The platform continuously evolves with new features and capabilities. For technical support, or to provide feedback, please contact the NEMOSHIP support team:

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