



## **FlexOffer Manager User Manual**

**March 2021**

## Introduction

FlexOffer Manager (FMAN) - is an ATP sub-system for aggregators, balance responsible parties (BRPs), micro-grid responsible (MGRs), which allows managing (potentially large) collections of flexible loads in the FlexOffer form. It integrates advanced FlexOffer aggregation and disaggregation functionalities, optimization, as well as Graphical User Interface (GUI), which allows its users to effectively and efficiently analyze, trading, and shaping available flexibility in near real-time.

FMAN is an intermediate ATP sub-system that, in near real-time, collects FlexOffers from one or multiple FOAs (FlexOffer Agents), optimizes loads (FlexOffers) for a specific user-defined optimization objective (e.g., demand-supply balancing), and trades flexibility on FlexOffer Market (FMAR) based on available FlexOffers. At the time of writing, FMAN is currently connected to a single FOA for TP-Link smart-plugs and the Swiss Cloud-IO; and a single FMAR system hosted by INEA.

FMAN manages two kinds of assets, *Prosumer Loads* and *Market Orders* (commitments), along with their associated costs. The collection of these assets constitute the *Aggregator's portfolio*, which is continuously optimized by FMAN (and used to derive new FMAR trading bids).

- **Prosumer Loads:** Each FlexOffer provided by a prosumer (directly or via FOA) incurs some monetary reward to be provided by an FMAN user (i.e., FlexOffer consumer: aggregator, BRP, MGR) to the prosumer (i.e., FlexOffer provider). The amount of this reward is governed by a so-called *user contract*, established between the FO provider (prosumer) and FMAN user (e.g., aggregator), and may vary depending on, e.g., the total number of issued FOs, total amount of time or energy flexibility provided, etc. FMAN manages such user contracts, as well the actual rewards exchanged between the market actors.
- **Market Orders:** FMAN continuously generates and submits market bids to FMAR. Bids that get accepted on the market become firm *market orders (commitments)*. In addition to a monetary amount to be paid out by a market (FMAR) participant to an FMAN user (aggregator), such market orders define *schedules*, containing energy amounts that have to be collectively consumed or produced by all FMAN's FO providers. Deviations from such schedules incur imbalances that, depending on a so-called *market contract*, may lead to FMAN user (aggregator) losses. FMAN manages such bids, market orders, market contracts, imbalances, and imbalance fees.

Thus, the FMAN user (aggregator) absolute profit can be expressed as the sum of market order gains ( $G_{\text{Market}}$ ), market order imbalances ( $C_{\text{Market}}$ ), rewards (or energy discounts) to be paid to Prosumer for issuing (and executing) their FOs ( $C_{\text{FOS}}$ ), and some other fixed costs ( $C_{\text{Fixed}}$ ):

$$\text{AggregatorProfit} = \sum G_{\text{Market}} - \sum C_{\text{Market}} - \sum C_{\text{FOS}} - \sum C_{\text{Fixed}} \quad (1)$$

FMAN gives flexibility to its users (aggregators) in defining the attributes of *user contracts* and *market contracts* and setting load *aggregation, optimization and trading* parameters, and so the system can

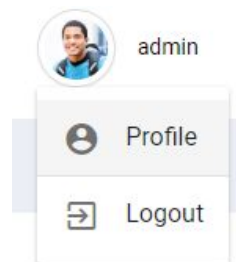
effectively be used in various demand-response scenarios across the demo sites and beyond. For example, if aggregation is enabled and trading is disabled, in this configuration, FMAN can be used as a stand-alone demand-supply balancing tool for, potentially, a large number of loads (FOs) in a certain area (energy community, DSO area, or balance group).

The documented is divided into several sections. The first section details the initial configuration steps, while the remaining sections describe the important features that are available in FMAN.

## 1. Initial Configuration

### 1.1. First-time system sign-in

You must be a registered user to access the FMAN system. Initially, the system has a single pre-defined administrator user, whose username is “admin” and the password is “admin”. Please use this for your first login. However, we strongly recommend changing this default password in the user profile page, accessible from “Configuration > User Profile” or, alternatively, the top header.



In addition, we recommend setting your location, as described below.

### 1.2. Add Location

For proper rendering of users on the map, users have to provide their geographical locations. This can be done by navigating to the “Configuration > User Profile” page in the FMAN GUI (available in the side navigation panel). The page allows users to add/update the location among other things. The location can be added/modified by typing in the address box, selecting one of the suggestions, and clicking on the ‘**Update**’ button at the bottom of the form to complete the process. The location can also be set by directly clicking on the map, then clicking on the ‘**Update**’ button.

User Name

admin

Password

Repeat Password

First Name

Admin

Last Name

User

Email

admin@email.com

User Role

ROLE\_ADMIN

Is Enabled?

☒

Location

Selma Lagerl fs Vej, Aalborg, Denmark

Update

Clear

Delete the profile

### 1.3. Creating additional user accounts

If multiple users need to access the system, a new user account can be created by the system administrator by opening the user-list page (“User > List”), clicking “Sign-up a new User” , and filling the sign-up form.

Users

Map

List

Sign Up

First Name \*

Last Name \*

Username \*

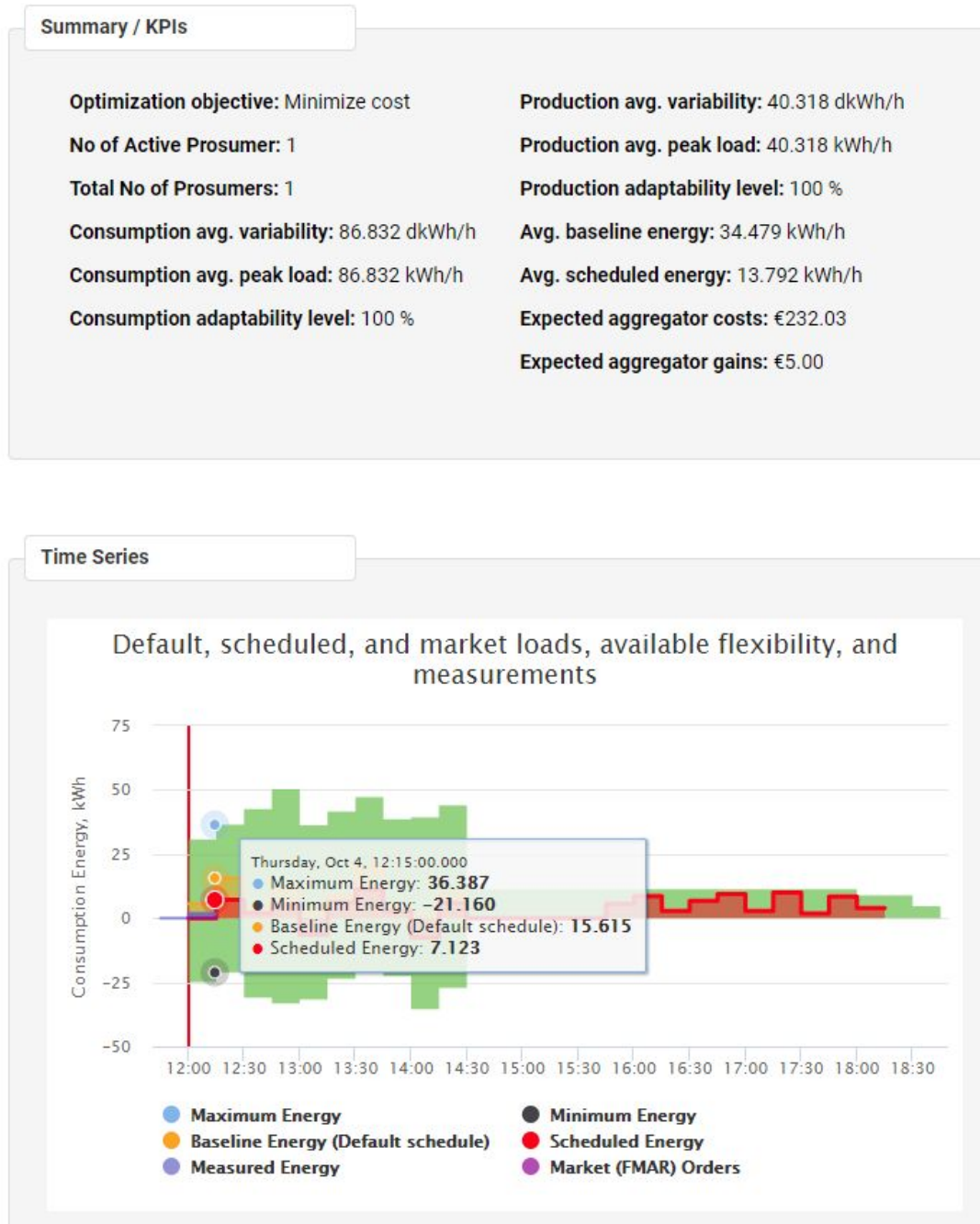
Email \*

Password \*

Register

## 2. The dashboard

The dashboard is the default (main) FMAN page, showing the summary, live Key Performance Indicator (KPI) values, and various time series that represents the active system state.



As seen in the figure, the dashboard shows basic information such as the current load optimization objective selected, number of active users, and the total number of users. The remaining numbers are

KPI values that characterize (summarize) the active aggregator portfolio: current consumption and production adaptability level, expected and scheduled energy amounts, as well as expected FMAN user gains and costs. The chart below shows aggregated both historical and expected future loads, separated by the vertical red line that represents the current time. Here, we distinguish between (1) baseline (default) user amounts, (2) optimized / scheduled (FO) amounts, (3) maximum and (4) minimum amounts realizable (schedulable) for specific time interval, (4) market order amounts, and (5) actual measurement amounts from prosumers.

Specifically, the presented KPI values cover the full (future) time interval of the active portfolio and have the following meanings:

**Consumption average variability** - this KPI characterizes the level to which the consumption can be varied by utilizing FlexOffers in the active portfolio. It is computed by subtracting minimum energy values from maximum energy values (see Time Series), averaging resulting delta values, and then converting energy(/15min) to power (multiplying by 4).

**Consumption average peak load** - this KPI characterizes average peak consumption, which can be realized by utilizing FlexOffers in the active portfolio. It is computed by taking an average value of maximum energy (see Time Series) and converting it into power (multiplying by 4).

**Consumption adaptability level** - this KPI characterizes the level to which the consumption can be varied with respect to the peak load by utilizing FlexOffers in the active portfolio. This is the ratio between *Consumption average variability* and *Consumption average peak load*, shown as a percentage.

**Production average variability, production average peak load, and production adaptability levels** are defined analog to the above (by taking only the negative instead of positive values of the Time Series chart).

**Average baseline energy** - this KPI characterizes average energy requested/offered *by Prosumes*, i.e., it is a sum of energy values of the default profiles of Prosumer FlexOffers in the active portfolio.

**Average scheduled energy** - this KPI characterizes average energy requested *by the Aggregator* (e.g, due to FMAN requests and/or a selected optimization option), i.e., it is a sum of energy values of the schedule profiles of Prosumer FlexOffers in the active portfolio.

**Expected aggregator costs** - this KPI characterizes total expected aggregator expenses. This corresponds to the market order imbalances ( $C_{\text{market}}$ ), rewards (or energy discounts) to be paid to Prosumer for issuing (and executing) their FOs ( $C_{\text{FOS}}$ ), and some other fixed costs ( $C_{\text{Fixed}}$ ) in Equation 1 (see above).

**Expected market gains** - this KPI characterizes total expected aggregator gains. This corresponds to market order gains ( $G_{\text{market}}$ ) in Equation 1 (see above).

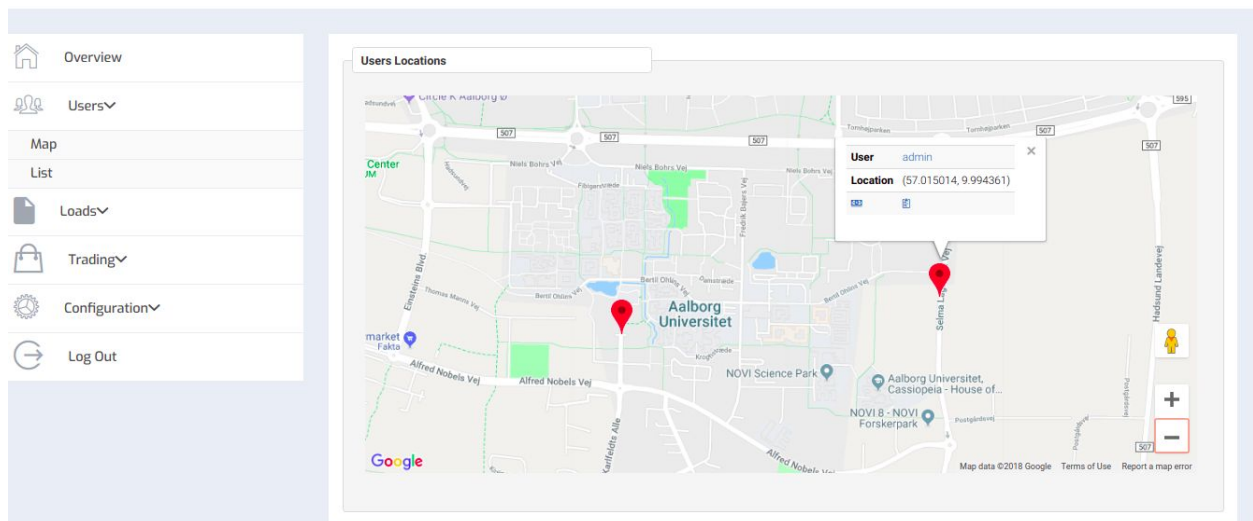
### 3. Users

The users' page provides information about various types of users registered with the system (administrators, brokers, and prosumers). It offers a map view as well as a list view as described below:

#### 3.1. Map View

The map visualizes the users on the map based on their geographical locations. Each user is represented by a red marker. Hovering mouse over a marker activates a pop-up window, showing the following information for the user:

- The username which can be clicked to navigate to the user's profile page.
- The user's location (latitude and longitude).
- A bill icon (the one on the left) which is essentially a link to the user's bill page.
- A contract icon which is a link to the user's contract page.



#### 3.2. List View

The list view offers some extra information in addition to the above. Prosumers and system users are listed in separate sections. The **“actions”** column contains links to the user's profile, bill, and contract pages. At the bottom of the page, there is a link to register a new user.

Overview

Users

Map

List

Loads

Trading

Configuration

Log Out

## Prosumers

#	Username	First Name	Last Name	Actions
1 (2)	muhaftab	Muhammad	Aftab	<a href="#">Edit</a> <a href="#">Details</a>

## System Users

#	Username	First Name	Last Name	Role	Actions
1	admin	Admin	User	ROLE_ADMIN	<a href="#">Edit</a> <a href="#">Details</a>
2	AAU	AAU	AAU	ROLE_BROKER	<a href="#">Edit</a> <a href="#">Details</a>
3	SWISS	SWISS	SWISS	ROLE_BROKER	<a href="#">Edit</a> <a href="#">Details</a>
4	TEST	TEST	TEST	ROLE_BROKER	<a href="#">Edit</a> <a href="#">Details</a>
5	SWW	SWW	SWW	ROLE_BROKER	<a href="#">Edit</a> <a href="#">Details</a>
6	CYPRUS	CYPRUS	CYPRUS	ROLE_BROKER	<a href="#">Edit</a> <a href="#">Details</a>

[Sign Up a New User](#)

### 3.3. User Bill

As mentioned above, the bill page for a user can be navigated to by clicking on the bill icon on the map or in the list. Users can see total offered flexibility, assigned schedule deviations from the baseline (default schedule), and the resulting total reward. Users can also specify the month using the Date input box above the table.

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## User Bill: AAU

**Date:**

Item	Value	Price
Number of flexoffers	0	
Fixed reward for all flexoffers		€0.00
Total Time Flexibility	0 timeStamp units (15min)	€0.00
Total Energy Flexibility	0 dkWh	€0.00
Number of default schedule deviations	0	€0.00
The sum of stat-time scheduling deviations with respect to the default schedule	0 timeStamp units (15 min)	€0.00
The sum of energy deviations with respect to the default schedule	0 dkWh	€0.00
<b>Total Reward</b>		<b>€0.00</b>

### 3.4. User Contract

The contract page shows the agreed contract between the prosumer and aggregator. The contract governs the rewards earned by the prosumers. The FMAN user (aggregator) can modify the terms of the contract and save the changes by clicking the “Update” button at the bottom.



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### Contract between Aggregator and the User: AAU

Reward (in EUR) for a single unit (dkWh) of energy flexibility

Fixed reward (in EUR) for issuing at least 1 flexoffer

Reward (in Euro) for a single unit deviation (kWh) in energy amount compared to the default schedule (baseline)

Fixed reward paid for deviating a single timeStamp (1 flexoffer) from the default schedule (baseline)

Reward (in EUR) for a single unit deviation (15 min) from the default schedule (baseline)

Reward (in EUR) for a single unit of timeStamp flexibility

Allowed limit of imbalance (kWh) between scheduled and actually consumed/produced energy for the user offer to be considered correctly executed.

Update

### 3.5. User Profile

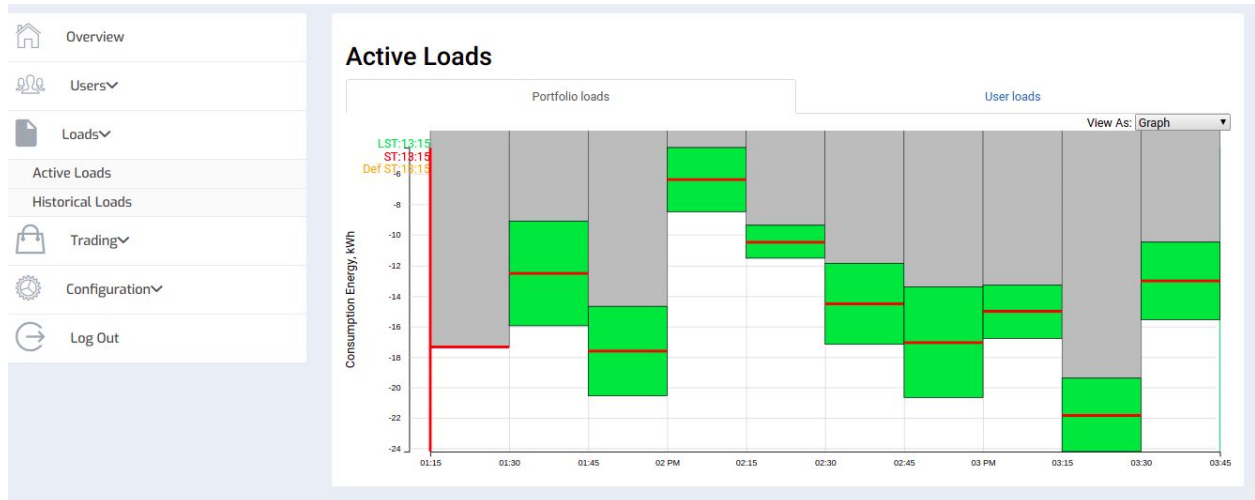
User profile page is explained in Section 6.1.

## 4. Loads

The page shows the FlexOffers received from prosumers, either directly or via FlexOffer Agents (FOAs).

### 4.1. Active Loads

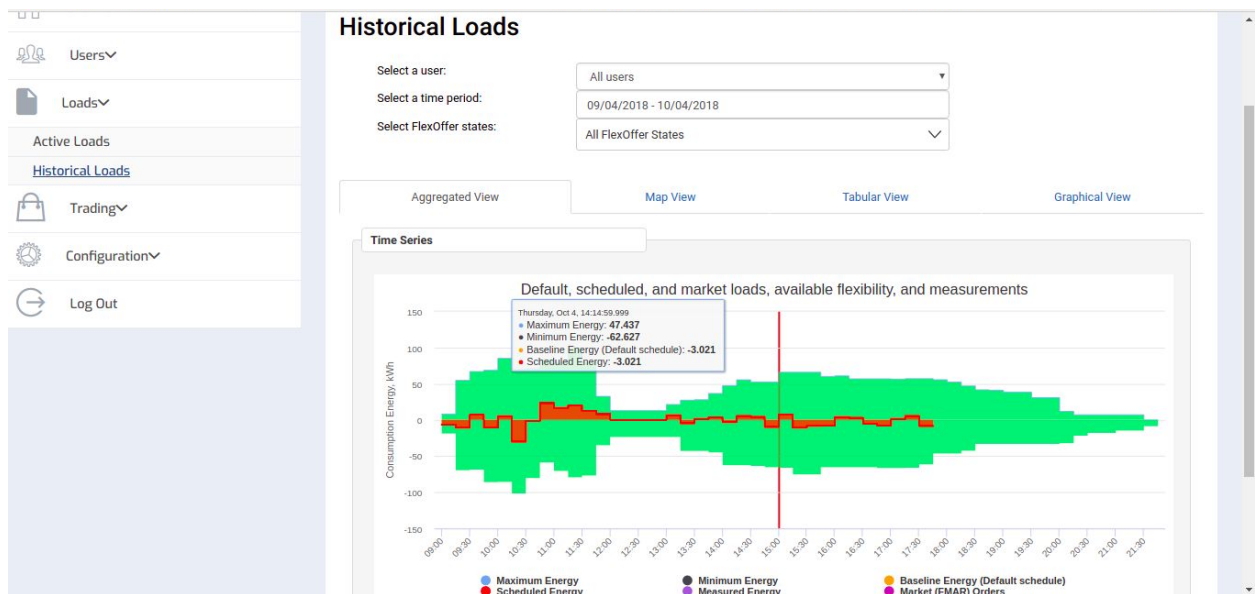
It shows the FlexOffers that are currently in an active state (INITIAL, ACCEPTED or ASSIGNED). The page has two tabs. The first tab shows the FlexOffers that are part of the Aggregators overall portfolio, while the second tab shows the FlexOffers by users. By default, the graphical view is shown. However, it also offers a *tabular* view, *cost function* view, and *map* view which can be displayed by clicking on “**View As**” in the upper-right corner of the figure and choosing an appropriate item from the drop-down menu.



## 4.2. Historical Loads

Here, users can see all the historical FlexOffers. FlexOffers can be filtered by user, time period, and FlexOffer states. The filtered FlexOffers can be viewed in four different ways (each in a separate tab) as described below:

- **Aggregated view:** It shows the same information as shown in the Dashboard's figure but for the currently filtered FlexOffers only.



- **Map view** It offers a geographic representation of the filtered FlexOffers. Each FlexOffer is shown as a red marker on the map. Hovering the mouse over a marker shows the FlexOffer details in a pop-up window.

Users

Loads

Active Loads

Historical Loads

Trading

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Log Out

## Historical Loads

Select a user:

All users

Select a time period:

09/04/2018 - 10/04/2018

Select FlexOffer states:

All FlexOffer States

Aggregated View

Map View

Tabular View

Graphical View

- **Tabular view** It offers a tabular representation of the filtered FlexOffers.

Users

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Active Loads

Historical Loads

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Log Out

## Historical Loads

Select a user:

All users

Select a time period:

09/04/2018 - 10/04/2018

Select FlexOffer states:

All FlexOffer States

Aggregated View

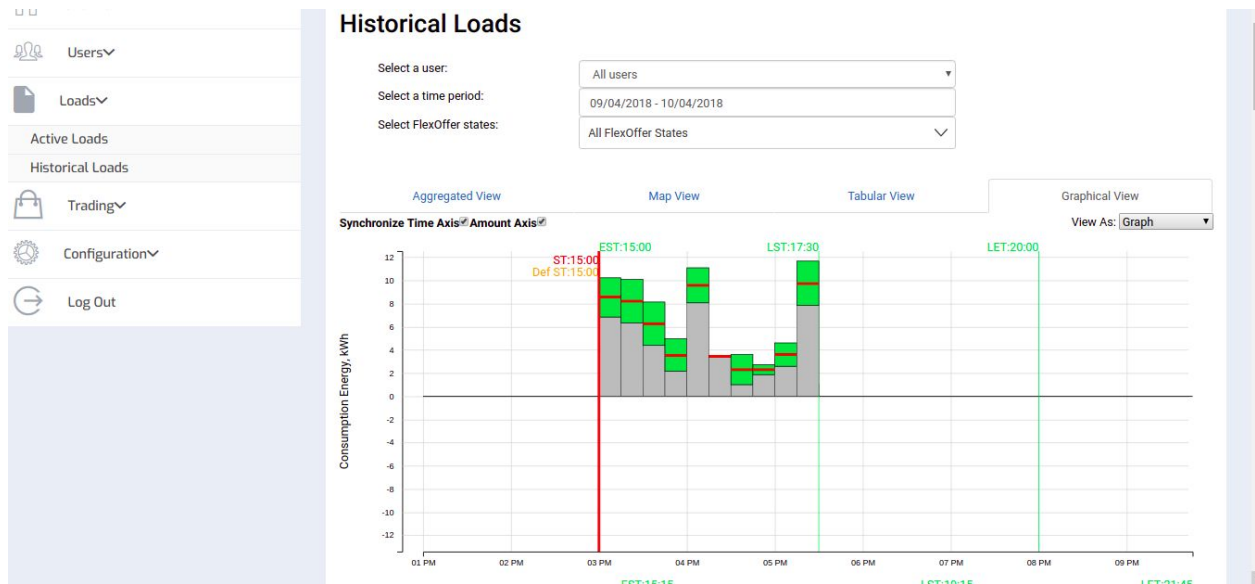
Map View

Tabular View

Graphical View

Id	User	Creation Time	FlexOffer Status	Offer
9be4b6d8-8186-4a2f-9c6b-44de7a178a80	admin	Today at 3:04 PM	Accepted	Show Offer
c3e2fa3f-680f-47a9-b7ea-33b84ad57373	admin	Today at 3:04 PM	Accepted	Show Offer
cdb19de0-7259-46f3-83f5-50e1d0698ce7	admin	Today at 1:58 PM	Executed	Show Offer
65a9bddf-ab21-4661-9689-ab2ec5bd05d4	admin	Today at 1:58 PM	Executed	Show Offer
03aa9829-96ff-4a52-bf06-e10c2be10a58	admin	Today at 1:57 PM	Executed	Show Offer
b2b5e5e5-f36c-42ec-955c-ce7c53044705	admin	Today at 1:57 PM	Executed	Show Offer
9f65c613-0e47-472b-97ba-e56e687fddb9	admin	Today at 1:03 PM	Executed	Show Offer
c694c472-85f2-4adf-8f5a-2afe214afe78	admin	Today at 1:03 PM	Executed	Show Offer
6ead767b-3a67-48fa-96f8-46a36a715460	admin	Today at 1:03 PM	Executed	Show Offer

- **Graphical view** It offers a graphical view similar to Active Loads page.



## 5. Trading

### 5.1. Status

The page summarizes both an active aggregator's portfolio (the loads which are traded), as well as the last still active bid issued for trading.

## Status

Bid has been submitted and waiting for market response

## Aggregator Portfolio

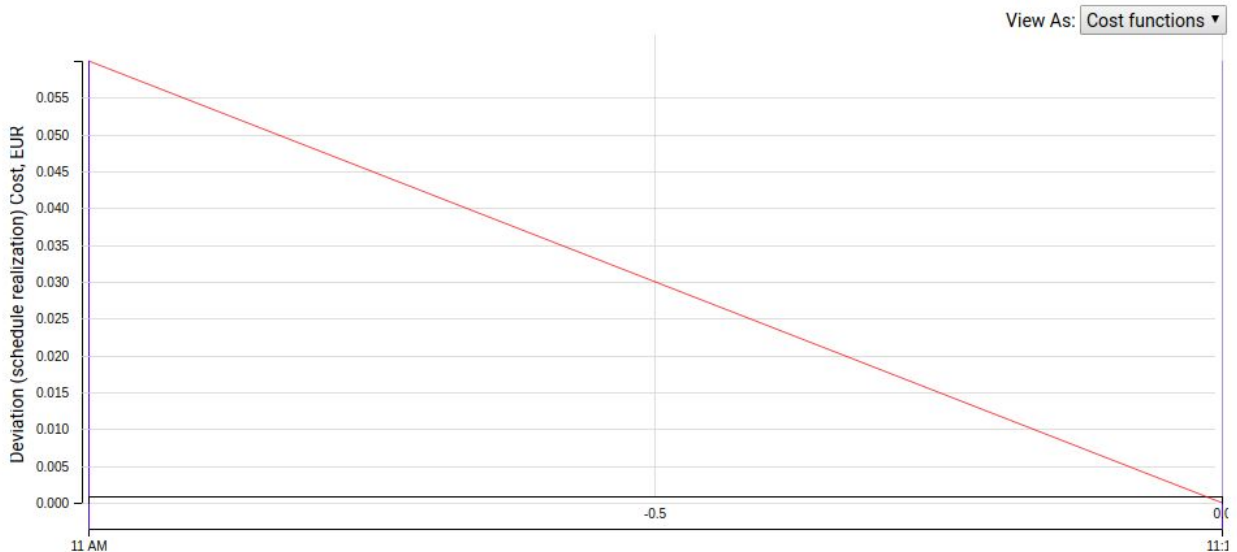
	Count / Amount	Expected Costs
Fixed Losses and Expenses	-	€0.00
Active FlexOffers	2	€0.00
FMAR Orders (Commitments)	0	€0.00
FMAR Imbalance Fee	0 kWh	€0.00
Total Portfolio Cost	-	€0.00

Send or update an FMAR bid now

## Last FMAR Transaction

Based on the active loads available, the system has issued an offer to the INEA's FMAR.

Transaction Time	Today at 10:45 AM
Trading Interval	Today at 11:00 AM - Today at 11:14 AM
Offer Status	Flex-Offer Accepted
ID of the Offer in INEA's FMAR system	3043222



As seen at the top of the figure, this page focuses on the financial aspects of the portfolio, i.e, the constituents of Equation 1: fixed losses/expenses, FlexOffers costs, market order gains, market imbalance costs, and the total portfolio cost.

As seen at the bottom of the figure, this page shows details about the last issued bid: the time when the bid was issued (transaction time), trading interval, bid-offer status, Id of the offer in the FMAR system. As the bid offer is represented by a FlexOffer, different options to analyze this bid offer are provided. In the figure, the activated “Cost functions” view shows the relationship between bid amounts (expected gains, in EUR) and different realizations of available flexibility with respect to the default (baseline) schedule (0.0 amount on the X-axis).

## 5.2. History

This page allows analyzing all market orders, as well as all other market transactions (bids) issued in the selected time interval. For each market order, it shows bid issuing time (transaction time), FMAR Id, requested deviations from the balance (a market schedule), as well as expected gains for fulfilling the market order. If sufficient power measurement data is available (from prosumers, FOAs), market orders can be successfully validated and the factual market order imbalances and gains can be computed.

### Trading History

Please select the time period:

09/04/2018 - 10/04/2018

Market Orders (commitments)					All transactions		
Transaction time	FMAR ID	Offer	Requested deltas	Expected gain	Factual imbalance	Factual imbalance fee	Factual gain
Today at 12:45 PM	811130	* Show Offer	5.87 dkWh	€0.29	No sufficient data to validate		
Today at 12:30 PM	811092	* Show Offer	-15.00 dkWh	€0.75	No sufficient data to validate		
Today at 12:20 PM	811067	* Show Offer	-7.42 dkWh	€0.37	No sufficient data to validate		
Today at 11:53 AM	-1	* Show Offer	-5.00 dkWh	€5.00	2 kWh	€2.00	€3.00

Please select the time period:

09/04/2018 - 10/04/2018



Market Orders (commitments)				All transactions	
State	Transaction time	FMAR ID	Offer Status	Offer	Schedule
Active	Today at 1:00 PM	811174	Flex-Offer Accepted	* Show Offer	No schedule
Active	Today at 12:45 PM	811130	Flex-Offer was scheduled	* Show Offer	Schedule available
Active	Today at 12:30 PM	811092	Flex-Offer was scheduled	* Show Offer	Schedule available
Active	Today at 12:20 PM	811067	Flex-Offer was scheduled	* Show Offer	Schedule available
Active	Today at 11:53 AM	-1	This is test transaction added by ADMIN	* Show Offer	Schedule available


First Previous **1** Next Last


## 6. Configuration


### 6.1. User Profile


Here, users can update their account details and location. In addition, Administrators can also assign a different role (i.e., ADMIN, PROSUMER, BROKER) to a user or disable the user altogether. The bottom of the page provides the option to delete the user.




 admin

 Overview


 Users▼

 Loads▼

 Trading▼

Status


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User Profile


Main Settings

Trading Settings

 Log Out

User Profile: admin

 Open user bill

 Open user contract

User Id

1

User Name

admin

Password

.....

Repeat Password

.....

First Name

Admin

Last Name

User

Email

admin@email.com

User Role


ROLE\_ADMIN ▼

Is Enabled?

☒

Location


search for location or select on the map



Update

Clear

Delete the profile



### 6.2. Main Settings

This page offers access to the essential parameters of FMAN. First, in this page, the user can toggle load (FO) aggregation, which significantly increases optimization performance, both in execution time and solution quality, for a larger number of loads (FOs,  $>>20$ ). Second, on this page, the user can enable or disable trading with Flexibility Market (FMAR). Finally, the user can select the desired load optimization

objective, which will optimize loads (FOs) either for demand-supply balancing, cost minimization, FMAR order execution, energy minimization, or maximization in a user-specified time period.

The screenshot shows a web application interface with a sidebar on the left and a main content area on the right. The sidebar contains a list of navigation items: Overview, Users, Loads, Trading, Status, History, Configuration, User Profile, Main Settings (highlighted), Trading Settings, and Log Out. The main content area is titled 'Main Settings' and contains three settings: 'Aggregation enabled' (checked), 'Trading enabled' (unchecked), and 'Optimization target' (set to 'Minimize cost').

**Main Settings**

**Aggregation enabled:** ☒  
This option increases optimization performance (speed and result quality) when many loads (>20) are available

**Trading enabled:** ☐  
This enables or disables flexibility trading with INEA's FMAR

**Optimization target:**   
Specifies which load optimization target is desired.

### 6.3. Trading Settings

In this page, the user can enable or disable FMAR trading, as well as set and/or fine-tune specific bid generation parameters:

The screenshot shows a web application interface for 'Trading Settings'. It contains several settings: 'Trading Enabled' (radio buttons for Yes and No), 'Trade frequency' (dropdown menu), 'Trading horizon' (dropdown menu), 'Bid update policy: update an active bid on absolute energy change (kWh)' (text input), 'Trade margin: proportional to deviation' (dropdown menu), 'Trade margin: absolute margin at maximum deviation (EUR)' (text input), 'Market (FMAR) contract : imbalance fee (EUR / kWh)' (text input), and 'Market (FMAR) contract : imbalance cut-off amount (kWh)' (text input). A 'Save' button is at the bottom left.

**Trading Settings**

**Trading Enabled:** ☒ Yes ☐ No

**Trade frequency**

**Trading horizon**

**Bid update policy: update an active bid on absolute energy change (kWh)**

**Trade margin: proportional to deviation**

**Trade margin: absolute margin at maximum deviation (EUR)**

**Market (FMAR) contract : imbalance fee (EUR / kWh)**

**Market (FMAR) contract : imbalance cut-off amount (kWh)**

**Save**



- **Trade frequency**

This parameter defines the frequency at which new FMAR bids (orders) are generated. Note, FMAR allows submitted bids/orders to be updated, either until the latest possible load (FO) assignment time or until the market schedule is generated by FMAR and delivered to FMAN (a bid becomes the market order). The frequency of such bids updates is controlled by the “bid update policy” parameter, described below.

- **Trading horizon**

This parameter defines the trading horizon, i.e., the time interval covered by a single bid order. It must be a multiple of 15 mins, leading to bid orders with a number of slices matching respective 15 min intervals.

- **Bid update policy: update an active bid on absolute energy change (kWh)**

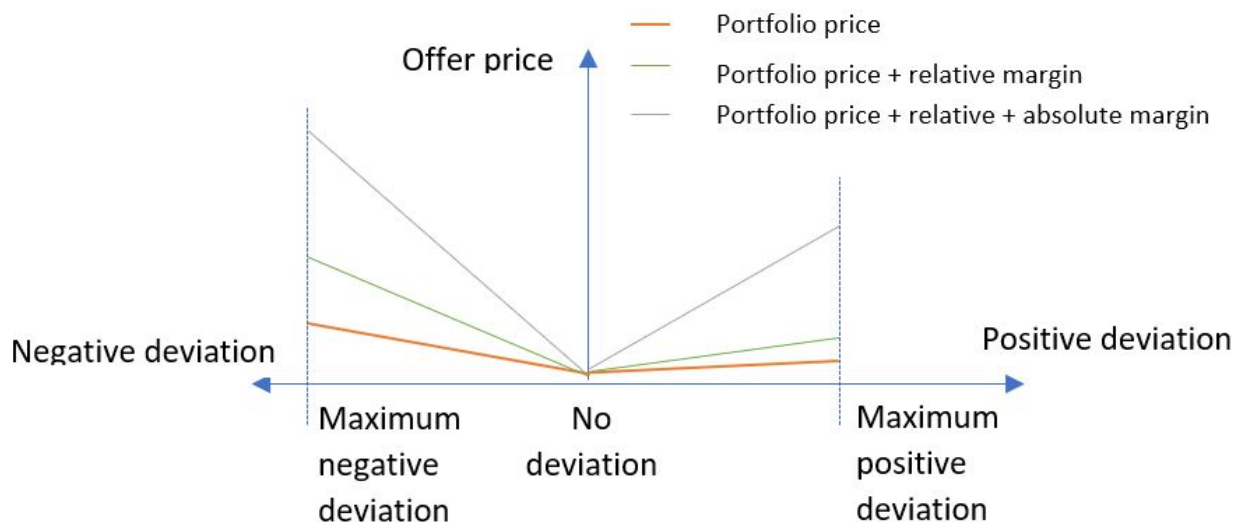
This parameter defines a condition to trigger a bid update - to better position the FMAN’s bid/offer when changes in the FMAN portfolio occur. It specifies the energy amount (in kWh) the two market offers - old (already submitted to FMAR) and new (an update) are allowed to differ on their MIN/MAX energy bounds to trigger the update. Note, FMAR allows such updates either until a schedule is generated, or load (FO) assignments are no longer possible (execution needs to take place).

- **Trade margin: proportional to deviation**

FMAR automatically computes market order/bid prices by taking into account portfolio's costs incurred by scheduling of user loads according to (expected) market order schedules. This parameter allows further increasing (or reducing) bid prices proportionally to the requested deviation from the baseline, e.g., to increase FMAN user profit. Note, the value of 1 of this parameter will lead to bids barely covering actual load (FO) scheduling costs.

- **Trade margin: absolute margin at maximum deviation**

Like the previous parameter, this parameter specified absolute margin (in EUR) on top of the portfolio prices to calculate flexibility prices in bid offers. The effect of both the proportional (relative) and absolute margins to the ultimate bid offer prices are visualized as follows:



- **Market (FMAN) contract: imbalance fee**

This parameter specifies imbalance fee (Eur/kWh) for each kWh of imbalance energy, i.e., deviation between market order and actually consumed and/or produced energy amounts. Note, at the moment of writing, FMAN does not apply any imbalance fees. However, higher values of this parameter lead to the increased prioritization of market orders during load optimization. If such prioritization of market orders is desired, the value of this parameter has to be set to a very large number (100.000EUR/kWh).

Note, specific values of these parameters have to be tuned for a specific FMAN instance and/or configuration, as well as expected conditions and participants on FMAN.

- **Market (FMAN) contract : imbalance cut-off amount (kWh)**

This parameter specifies the maximum allowed imbalance amount (kWh) from which the imbalance fee is applicable. I.e., if the factual imbalance is below this threshold, no imbalance cost will be incurred; only imbalance amounts exceeding this threshold are subject to the imbalance fee.