Grid2Viz

Jan 25, 2022

Installation and starting-kit

Grid2Viz is a web application that offers several interactive views into the results of Reinforcement Learning agents that ran on the Grid2Op platform.

Installation
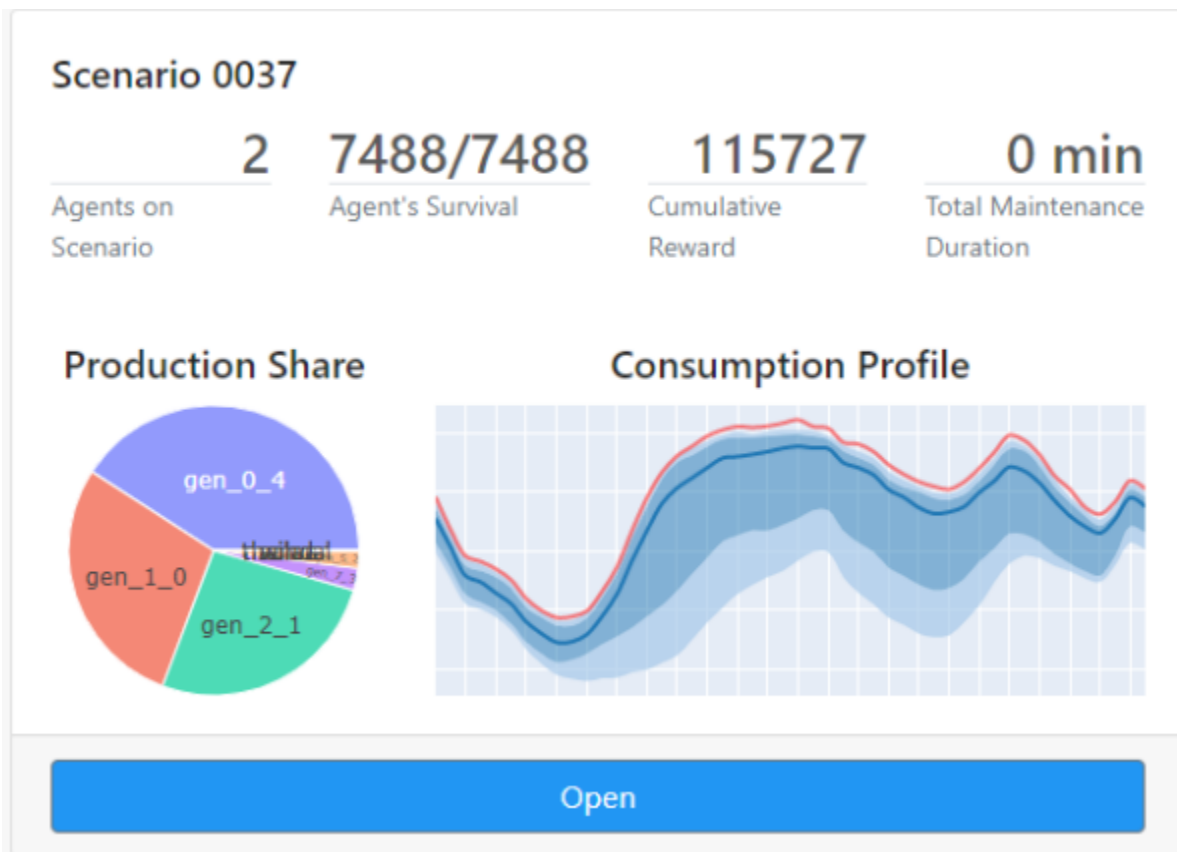
1.1 Requirements

- Python >= 3.6

1.2 Step 1 (Optional, recommended): Create a virtual environment

```
pip3 install -U virtualenv
python3 -m virtualenv venv_grid2viz
```

1.3 Step 2: Install from sources

```
source venv_grid2viz/bin/activate
git clone https://github.com/rte-france/grid2viz.git
cd grid2Viz/
pip install -U .
```

1.4 Step 2 (bis): Install from PyPI

```
source venv_grid2viz/bin/activate
pip install grid2viz
```

Running the application and Configuration

In order to use this tool, you need to have serialized the RL process of grid2op. The expected file system is :

- **root_dir**
    - **agent_1**
        * scenario_1
        * scenario_2
    - **agent_2**
        * scenario_1
        * scenario_2
        * scenario_3

Each of the scenario_* files have to contain all files given by serialisation of your RL through grid2op. In order to add a new agent to the app, you will have to add the agent's folder to this root_dir For the update process of this folder chain, see the section *Caching* (in particular, when you want to overwrite the current agents in root_dir with new versions with the same names)

The grid2viz commandline tool allows to start the server and provide all the necessary information. The help function of the tool can be found below.

```
usage: grid2viz [-h] [--agents_path AGENTS_PATH] [--env_path ENV_PATH] [--port PORT]
→[--debug] [--n_cores N_CORES] [--cache CACHE] [--warm-start WARM_START]
                [--config-path CONFIG_PATH] [--activate-beta ACTIVATE_BETA]

Grid2Viz

optional arguments:
  -h, --help            show this help message and exit
  --agents_path AGENTS_PATH
                        The path where the log of the Agents experiences are stored.
→(default to None to study the example agents provided with the package)
  --env_path ENV_PATH   The path where the environment config is stored. (default to
→None to use the provided default environment)
```

```
 --port PORT          The port to serve grid2viz on. (default to 8050)
 --debug              Enable debug mode for developers. (default to False)
 --n_cores N_CORES    The number of cores to use for the first loading of the best␣
→agents of each scenario
 --cache              Enable the building of all the cache data for all agents at␣
→once before relaunching grid2viz. (default to False)
 --warm-start         If True, the application is warm started based on the␣
→parameters defined in the WARMSTART section of the config.ini file. (default to␣
→False)
 --config-path CONFIG_PATH
                      Path to the configuration file config.ini.
 --activate-beta      Enable beta features. (default to False)
```

For example, to run the server on port 8000 with the default agents provided in the :doc: *Starting-Kit<starting-kit>*:

```
source venv_grid2viz/bin/activate
grid2viz --port 8000
```

2.1 Configuration

The –config-path argument allows to provide a configuration ini file to pass some options as describe bellow.

```
[DEFAULT]
agents_dir= # Same as the --agents_path command line argument
env_dir=# Same as the --env_path command line argument

[WARMSTART] # Section used to warm start the application form a specfici view
scenario= # Name of the scenario to be loaded
agent_ref= # Name of the reference agent to be loaded
agent_study= # Name of the study agent to be loaded
page= # End-Point of the view to be loaded (episodes, overview, macro, micro,␣
→simulation)
time_step= # Time step to be loaded
```

The command line arguments have precedence over the config file.

WARNING: Due to the caching operation the first run can take a while. All the agents present in the configuration files will be computed and then registered in cache. Depending on your agents it could take between 5 to 15min. You can follow the progress in the console.*

Starting Kit

Grid2Viz provides 2 agents with a scenario for one day and for one month available in *grid2viz/data/agents* folder:

- do-nothing-baseline
- greedy-baseline

By default the config.ini is targeting these agents as well as the environment configuration folders.

To launch this demo, just Run gri2viz with no arguments:

```
grid2viz
```

Caching

The cache system allows you to only compute long calculations of the app once per agent/scenario. The app will create a folder *_cache* in the *base_dir* of the config.ini which will contain these long calculations serialized.

If you add a new folder in your *base_dir* (either an agent, or a scenario) you will have to restart the server so the app reads the folder tree again.

WARNING : If you overwrite the agents while they were already cached, you will have to manually reset the cache so the app knows to compute everything again with the updated data. To do so, you just need to delete the *_cache* folder.
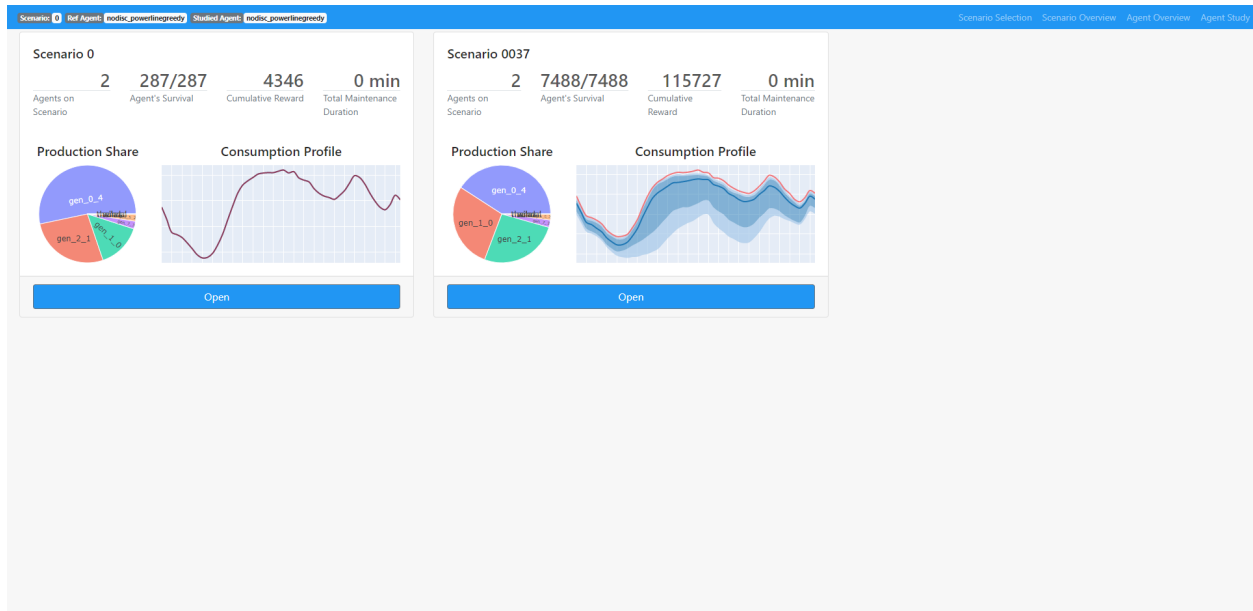
CHAPTER 5

Scenario Selection

This view offers a synthetic summary of the available scenarios and the agents that ran on these scenarios. Each card represent

- displays some synthetic indicators about the scenarios and the agents that ran on them
- can be further analyzed by clicking the **open** button which will open the Scenario Overview view

CHAPTER 6

Scenario Overview

The Scenario Overview view gathers some useful information about the selected scenario, through the "eyes" of the agent with the highest score on the scenario (called the best agent in the sequel). This agent is the one that survied the longest and thus that has seen the biggest part of the environment (among all the agents that ran on the scenario). It also provides some initial information about a reference agent that can be selected in this view. The view is composed of three main sections described below.

6.1 Indicators

This sections displays :

- A *Line chart* representing the **distribution of the daily consumption profiles** for the best agen.
- A *Pie Chart* for the **production shares** (in energy) for the best agent.
- **A set of indicators for the best agent :**
  - The number of time steps played over the duration of the scenario
  - The number of seen Hazards
  - The number of seen Maintenances
  - The duration, in minutes, of seen Maintenances

6.2 Summary
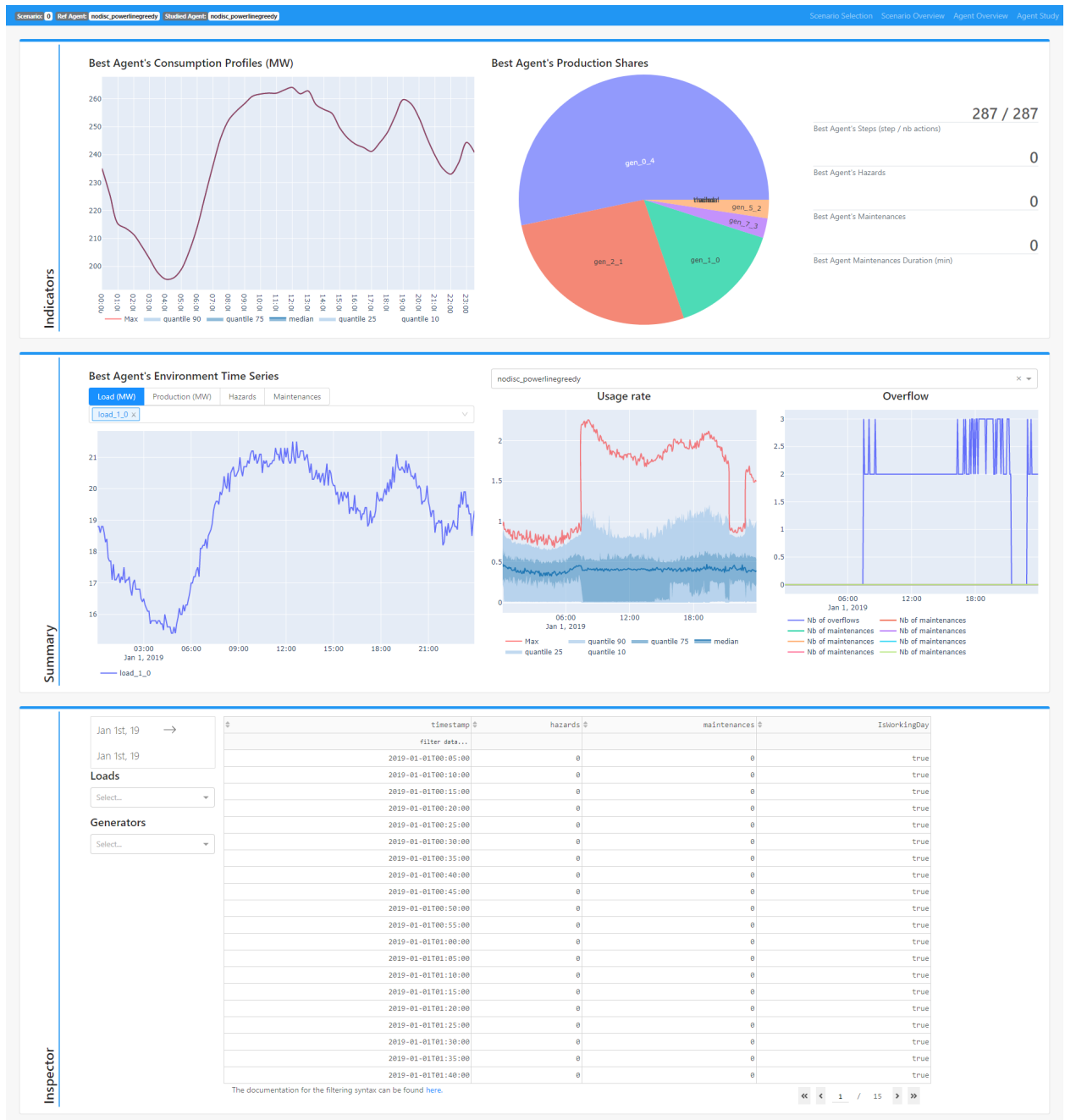
This section displays :

- A *Line chart* presenting the actual **environnement time series**, namely loads, productions, hazards and maintenances, seen by the best agent. You are able to search by name the individual elements you want to display. You can look at aggregated variable such as total load, wind, solar, hydro, nuclear and thermal productions.

- A *Dropdown* to select a reference agent that can serve as a baseline to compare with a studied agent. Any agent that ran on the scenario can be selected here.

- A *Line chart* representing some **quantiles of the usage rate** accross lines for the reference agent.

- A *Line chart* enumerating the **overflows** seen by the reference agent.

6.3 Inspector

This section displays a detailed interactive data table comprising the values of the environnement time series:

- You can filter the date range your interested in through a calendar.

- You can filter each column according to some values following the syntax here: https://dash.plotly.com/datatable/filtering

- You can add columns of the specific productions and loads you want to inspect through the search field.

Scenario: 0 Ref Agent: nodisc_powerlinegreedy Studied Agent: nodisc_powerlinegreedy   Scenario Selection   Scenario Overview   Agent Overview   Agent Study

Indicators

Best Agent's Consumption Profiles (MW)

— Max   quantile 90   quantile 75   median   quantile 25   quantile 10

Best Agent's Production Shares

gen_0_4, transformer, gen_5_2, gen_7_3, gen_2_1, gen_1_0

287 / 287
Best Agent's Steps (step / nb actions)

0
Best Agent's Hazards

0
Best Agent's Maintenances

0
Best Agent Maintenances Duration (min)

Summary

Best Agent's Environment Time Series

Load (MW)   Production (MW)   Hazards   Maintenances

load_1_0 ×

— load_1_0

nodisc_powerlinegreedy

Usage rate

— Max   quantile 90   quantile 75   median   quantile 25   quantile 10

Overflow

Nb of overflows   Nb of maintenances
Nb of maintenances   Nb of maintenances
Nb of maintenances   Nb of maintenances
Nb of maintenances   Nb of maintenances

Inspector

Jan 1st, 19 →
Jan 1st, 19

Loads
Select...

Generators
Select...

timestamp	hazards	maintenances	IsWorkingDay
filter data...			
2019-01-01T00:05:00	0	0	true
2019-01-01T00:10:00	0	0	true
2019-01-01T00:15:00	0	0	true
2019-01-01T00:20:00	0	0	true
2019-01-01T00:25:00	0	0	true
2019-01-01T00:30:00	0	0	true
2019-01-01T00:35:00	0	0	true
2019-01-01T00:40:00	0	0	true
2019-01-01T00:45:00	0	0	true
2019-01-01T00:50:00	0	0	true
2019-01-01T00:55:00	0	0	true
2019-01-01T01:00:00	0	0	true
2019-01-01T01:05:00	0	0	true
2019-01-01T01:10:00	0	0	true
2019-01-01T01:15:00	0	0	true
2019-01-01T01:20:00	0	0	true
2019-01-01T01:25:00	0	0	true
2019-01-01T01:30:00	0	0	true
2019-01-01T01:35:00	0	0	true
2019-01-01T01:40:00	0	0	true

The documentation for the filtering syntax can be found here.

« ‹ 1 / 15 › »

CHAPTER 7

Agent Overview

The Agent Overview offers some preliminary insights on the studied agent (compared to the reference agent selected in the *Scenario Overview* view). The view is composed of three main sections described below.

7.1 Indicators

This section allows to select the agent to be studied through a dropdown and :

- **Some synthetic information :**

  - The score

  - The number of overflows

  - The Number of actions played

- A *Pie Chart* representing the **types of actions** that the agent played.

- An *Histogram* representing the duration of Maintenances (counted on the whole scenario).

7.2 Overview

This section allows to interactively explore a series of 4 synchronised graphs :

- **Instant and Cumulated Reward** : Reward and cumulative reward time series for the reference agent and the studied agent. The time steps when the studied agent took an action are highlighted with a yellow mark.

- **Overflow and Maintenances** : Time series for the overflows generated by the studied agent and the maintenances seen by the agent.

- **Actions** : Time series for the action events (1 if an action is taken, 0 otherwise) and the distance of the current network topology from the orignal topology. Hovering over the action events time series will display the string representation of the action.

- **Usage Rate** : Same graph as in *Scenario Overview* but for the studied agent.

The time frame for these graphes is the one of the studied agent.

7.2.1 Time step Selection for Study

Additionnaly, clicking on any of the lines of the **Instant and Cumulated Reward** graph will select the corresponding time step and add it in the table on the left. These selected time steps will then be available in the *Agent Study* to allow specific focuses around those time steps.

7.3 Inspector for studied agent

This section offers a detailed table referencing the impacts of the actions taken by the studied agent. Clicking on any cell will display, below the table, the string representation of the action, if any, taken at the corresponding time step.

7.3.1 Summary of action used

The section is completed by two graphs representing histograms of substations and lines targeted by the action of the studied agent over the whole scenario.

Scenario: Scenario_august Ref Agent: CustomAgent Studied Agent: RandomAgent

Indicators

RandomAgent

34,716
Score

42
Number of Overflow

131
Number of Action

Type Action Repartition

0%

100%

■ Actions on Substations ■ Actions on Lines

Action Maintenance Duration (on the whole episode)

Overview

Timestep

filter data...

Select a timestep on the "Instant and Accumulated Reward" Time Serie to study it on the next page

Instant and Cumulated Reward

Aug 8, 2012

— CustomAgent_reward — CustomAgentcum_rewards — RandomAgent_reward
— RandomAgentcum_rewards ◆ Actions

Overflow and Maintenances

Aug 8, 2012

— Nb of overflows — Nb of maintenances

Actions

Aug 8, 2012

— RandomAgent — CustomAgent — RandomAgent distance — CustomAgent distance

Usage Rate

Aug 8, 2012

— Max quantile 90 quantile 75 median quantile 25 quantile 10

Inspector For Study Agent

Timestep	Timestamp	Reward	Action on line	Action on sub	Line name	Sub name	Action id	Topological distance
filter data...								
0	2012-08-08T00:00:00	1106.9422607421875	0	1		sub_16	0	0
1	2012-08-08T00:05:00	-10	0	1		sub_16	1	5
2	2012-08-08T00:10:00	-10	0	1		sub_16	2	5
3	2012-08-08T00:15:00	-10	0	1		sub_16	3	5
4	2012-08-08T00:20:00	1109.0208740234375	0	1		sub_16	4	5
5	2012-08-08T00:25:00	-10	0	1		sub_16	5	7
6	2012-08-08T00:30:00	-10	0	1		sub_16	6	7

« ‹ 1 / 19 › »

The documentation for the filtering syntax can be found here.

Click on a row to have more info on the action

Distribution of Substation action

sub_16   sub_14   sub_23   sub_26

Distribution of line action

No Actions on lines for this Agent

7.3. Inspector for studied agent

CHAPTER 8

Agent Study

The Agent Study view allows to explore further **around a time step of interest** the actions taken by an agent and their impacts. The view is composed of three main sections described below.

The navbar displays for this view a special component, namely a time frame selector. It is composed of a dropdown menu allowing to select one of the time step extracted from the *Agent Overview* view. The -5 and +5 buttons allows to extend the default time frame (10 timesteps on each side of the selected time step).

8.1 Indicators

This section displays the same **Instant and Cumulated Reward** and **Actions** graphs as the *Agent Overview* view, but centered around the selected time step.

8.2 Flow

This sections provides a Grid2Op plot representation of the grid. A slider, on the same time frame as the **Indicators** graphs allows to navigate between the corresponding grid states. The string representation of the action for a given time step is again provided below the slider.

The section is completed with a collection of time series representing flows accross lines (either in MW, Amps or usage rate) and voltages.

8.3 Context

The Context section is a useful reminder of the environment time series, as seen by the studied agent, the usage rate graph and the overflows and maintenances graph. It is intended to help explore in greater details the context in which an action was taken to have a comprehensive understanding of the situation.
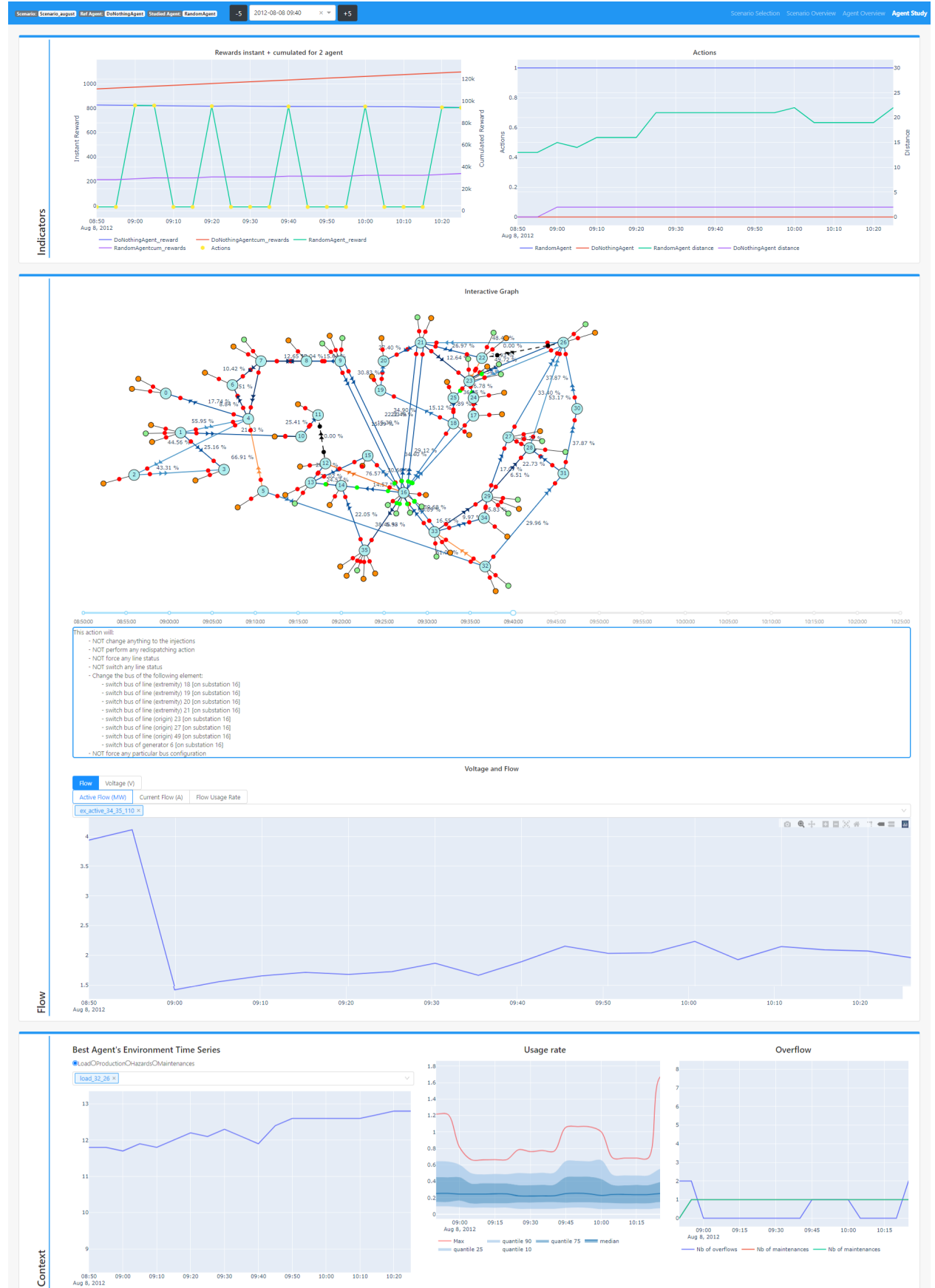
CHAPTER 9

Simulation

Note: The simulation view is still a BETA feature (works only with a DoNothing agent) and is accessible through the –activate-beta command line argument

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The Simulation view allows to replay a specific time step with custom actions, either built as a collection of atomic actions, or with an assistant. The resulting simulated observation can then be compared to the original observation.

This view allows to explore what would have happen if the agent had taken another set of actions.

As for the Agent Study view, the studied time step in the Simulation view can be selected in the Agent Overview view and then changed in the navigation bar.
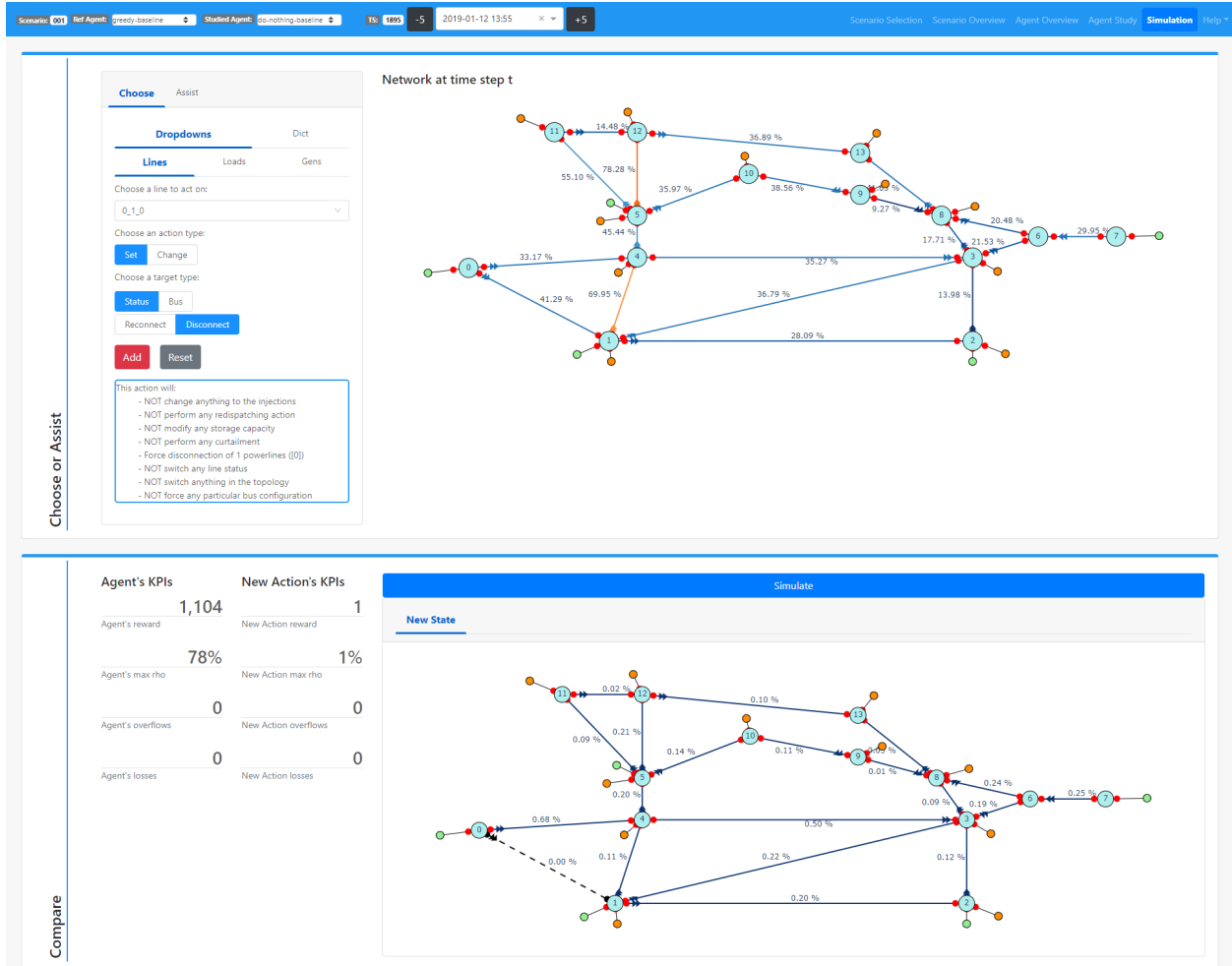
9.1 Chose or Assist

This section allows to configure the action to be simulated. Two options are available :

- A manual configuration through a set of radio buttons and dropdowns that allow to select a specific object and a specific action to apply on. Such actions add up with the Add button.

- An assisted action configuration through an assistant pluggin:

- Right now, only the expert system ExpertOp4Grid is provided with the application. An interface is exposed to implement other pluggins.

9.2 Compare

This sections provides the Grid2Op plot representation of the grid after the action has been simulated and a set of KPIs.

9.3 Use Case for the Assistant

With the data provided in the starting kit, we can go through a small use case of the ExpertOp4Grid assistant. Configuration :

- agent do-nothing-baseline

- scenario 000

- time_step 1895

- Line to Act on : 1_4_4

- Flow ratio (in %) to get below : 80 (The current flow is 83.95%)
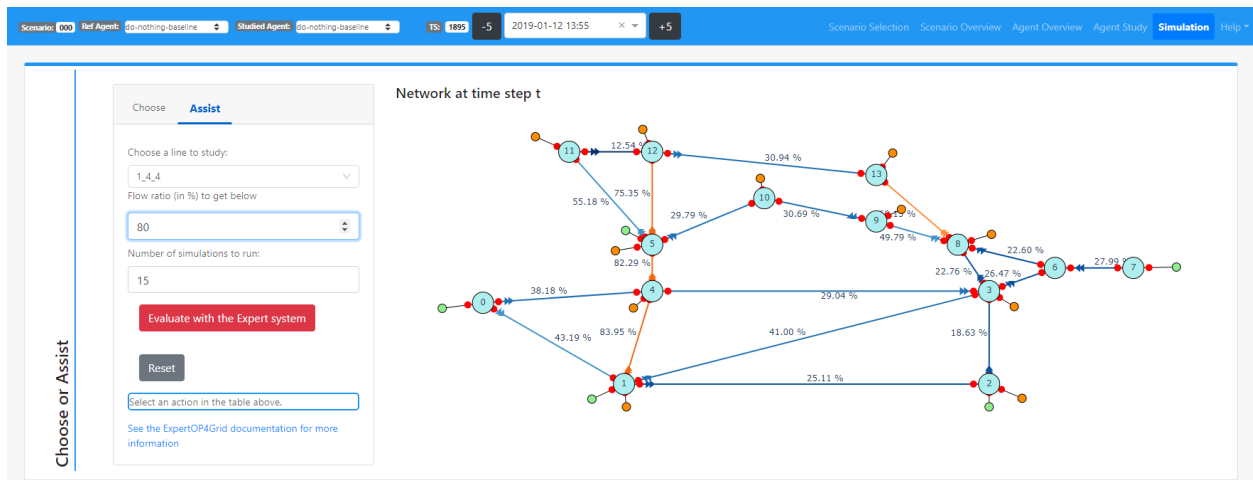
Evaluate the expert system and choose the first (i.e. best) action. It will reconfigure the substation 4 to make to flow on line 1_4_4 go below 80%.

You can now see the results by simulating the action in the Compare section. The flow on 1_4_4 is now way below 80% but at the cost of a higher flow on adjacent lines and higher losses.