Delivery 5.1

Description of implemented toolset for DSO

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DSO grid management tool

The DSO Tool is an online tool for the DSO that helps the DSO visualize the medium voltage grid on a historical basis in order to determine where bottlenecks may occur in the future. It also makes it possible to visualize the result of the DSO experiments that were carried out in the third heating season.

The current version visualizes a small part of the medium voltage grid where the many of the customers in the project were located. This encompasses six 10/0.4 kV transformers along with the 60/10 kV substation to which they are attached.

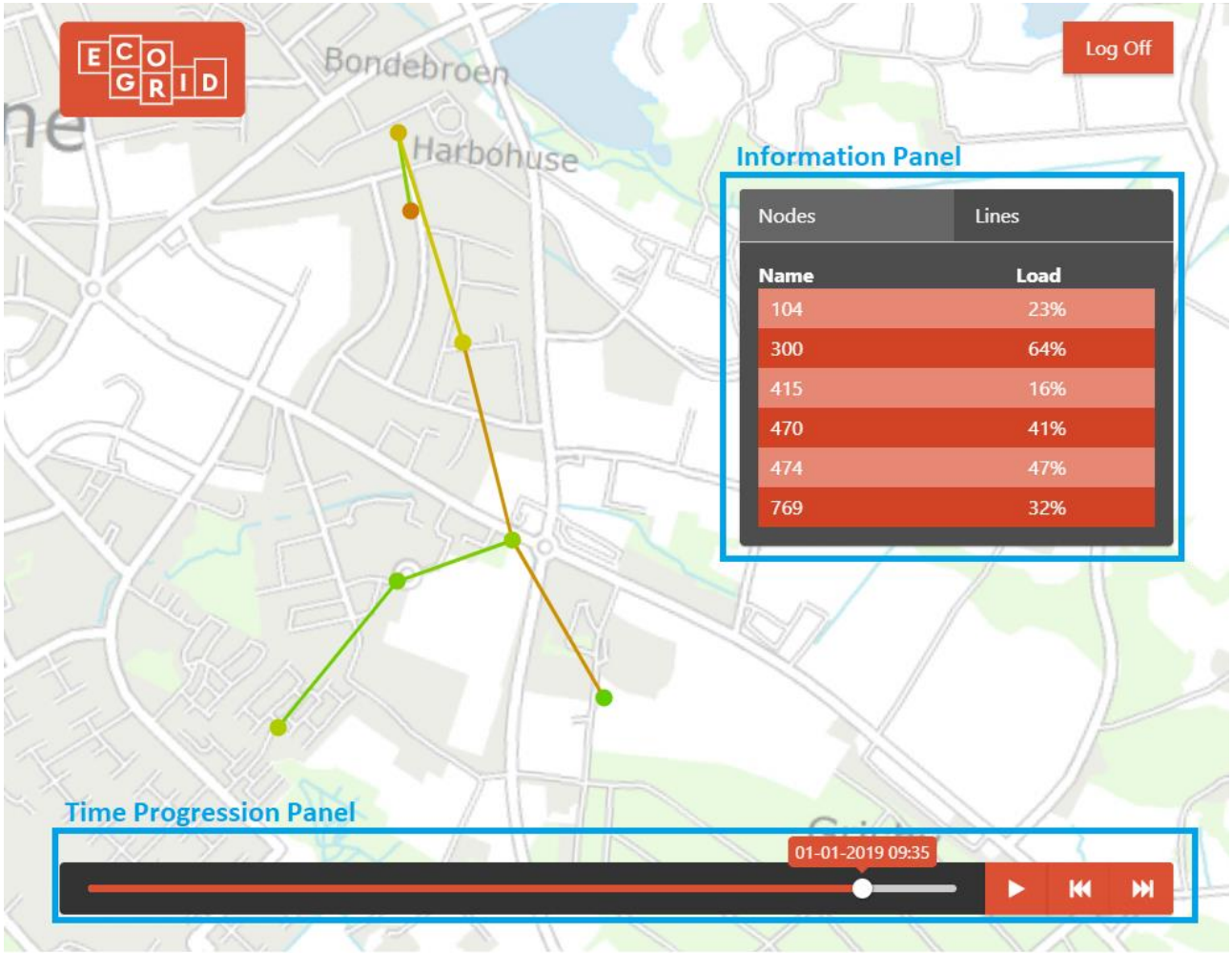

Figure 1: The DSO Tool Web Application

Figure 1 shows the application, along with the medium voltage grid used in the project.

The DSO tool application allows the user to perform the following actions:

- View the state of the grid at a specific point in time.
- View the state of the grid, as time progresses in steps of 5 minutes, 1 hour or 1 day per second using the **Time Progression Panel**.
- View the state of all transformers and connecting lines in the **Information Panel**.
- View the state of an individual transformer by clicking on it on the map.
- View the state of an individual line by clicking on it on the map.

View the state of the grid at a specific point in time and as time progresses

In the **Time Progression Panel** the user is able to click at any point in time that there is data for, to immediately view the state of the grid at that point in time. The use can also use the play button to allow time to progress by itself at different speeds. This is controlled with the play/pause/fast forward/fast backward buttons shown in the lower-right corner of the figure below.

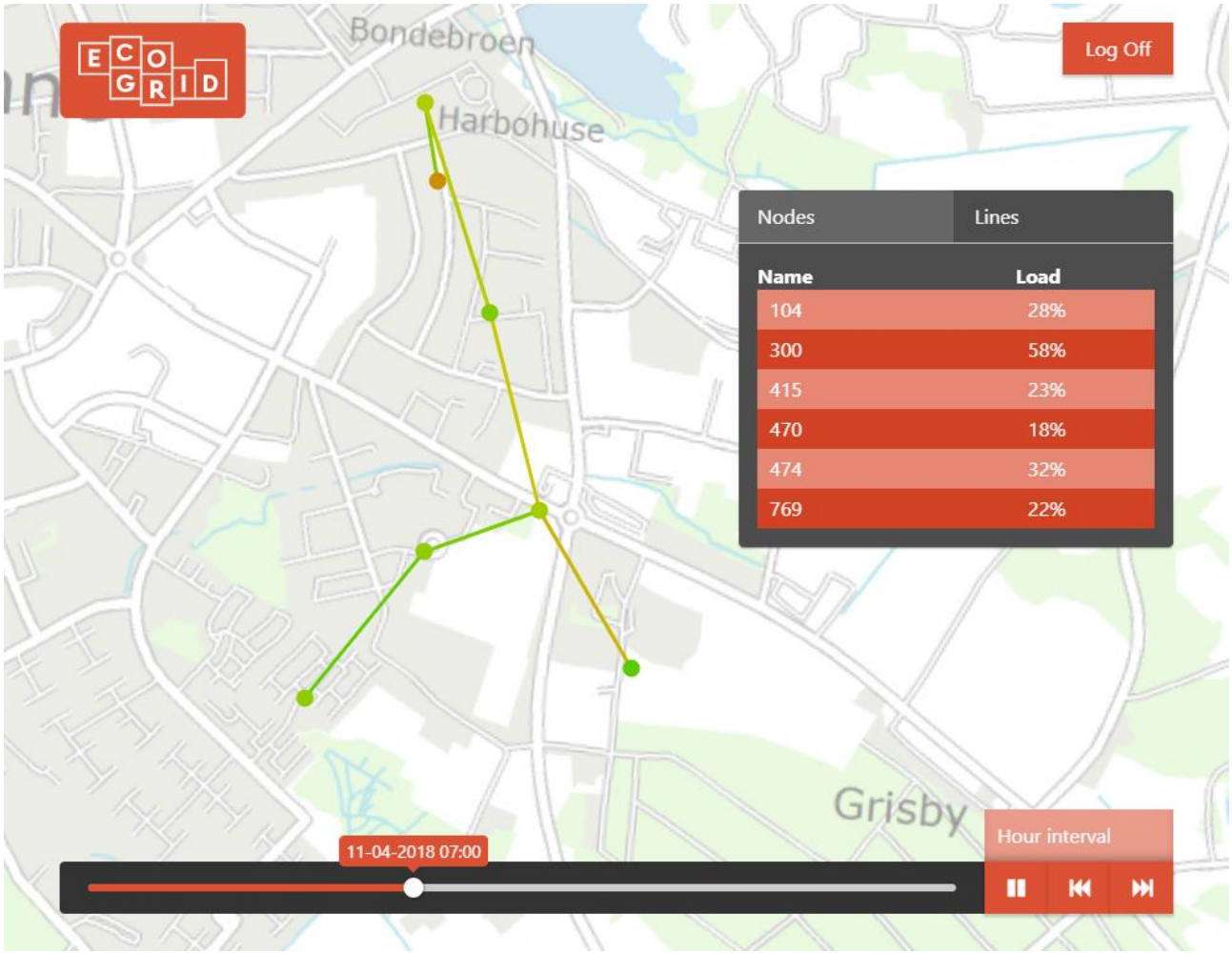

Figure 2: The application shows the state of the grid as time is progressing in one-hour steps

Figure 2 shows the application as time is progressing in one-hour steps per second. The color of the transformers and lines indicate their load level, where green means no load and red means it is fully loaded. When the load of a transformer or line goes beyond 100% it is colored purple to indicate that it has gone beyond its rating.

View the state of all transformers and connecting lines

In the **Information Panel** the user is able to view the load of all transformers and connecting lines.

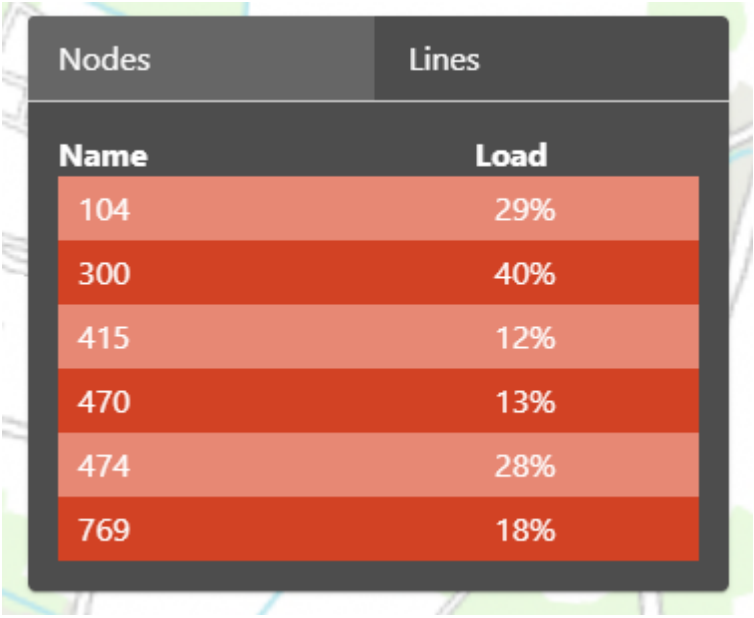

Figure 3: The load of all the transformers in the grid

Figure 3 shows the load of all transformers visualized in the grid. This enables to user to get a quick overview over any problematic loads.

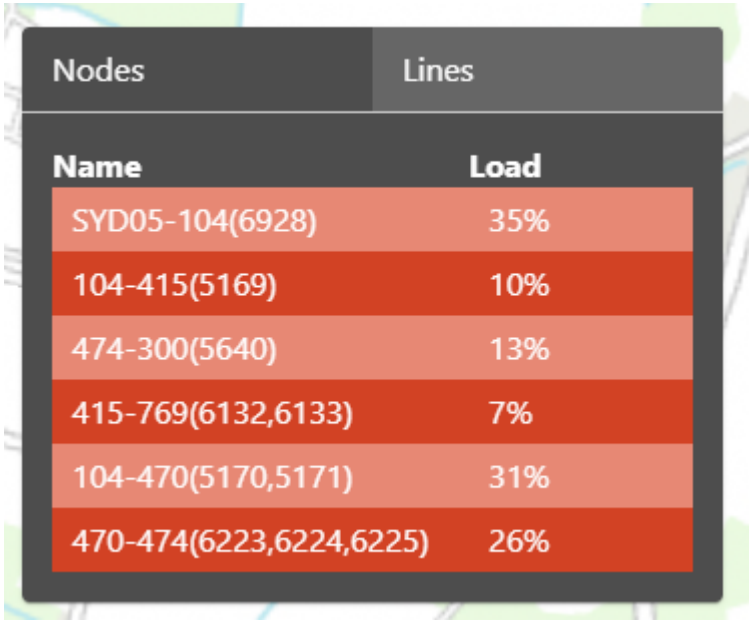

Figure 4: The load of all the connecting lines in the grid

Figure 4 shows the load of all connecting lines in the grid. This enables to user to get a quick overview over any problematic loads.

View the state of an individual transformer

When a transformer is clicked, the following information is displayed to the user.

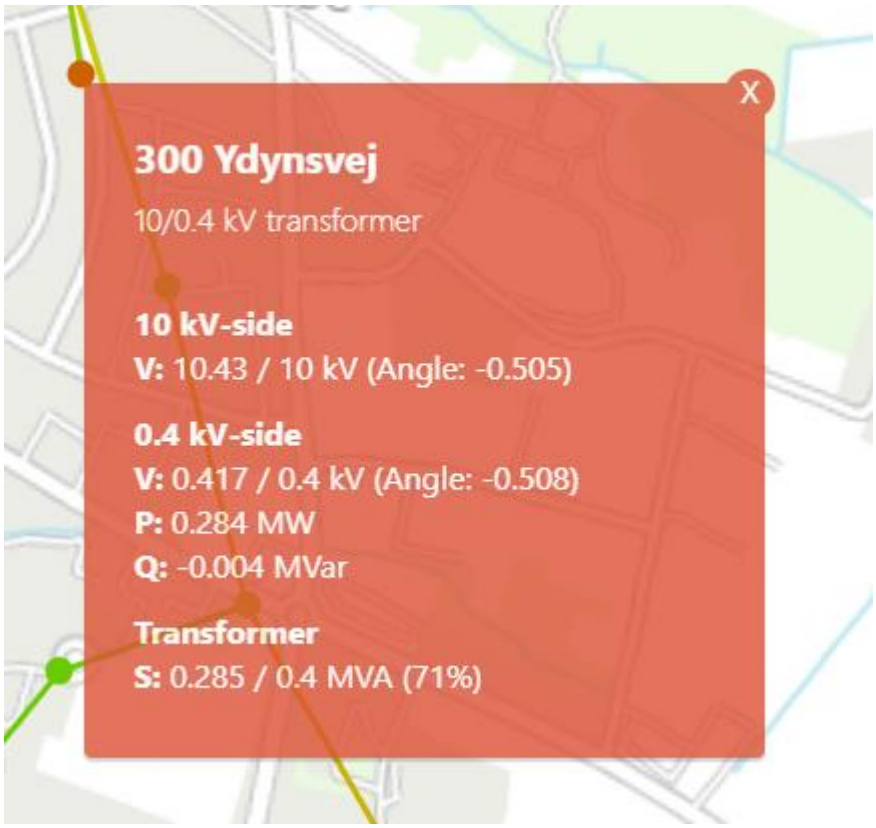

Figure 5: Information shown when clicking on a transformer

This shows information about:

- ID of the clicked transformer, along with the street name on which it is placed.
- Voltage measured on the 10 kV side.
- Voltage, power and reactive power measured on the 0.4 kV side.
- The load of the transformer itself compared to its rating along with how many percent this is equivalent to of its load rating.

In the shown example on figure 5, the clicked transformer has a significant load of 71% of it's rating of 0.4 MVA.

View the state of an individual line

When a connecting line is clicked, the following information is displayed to the user.

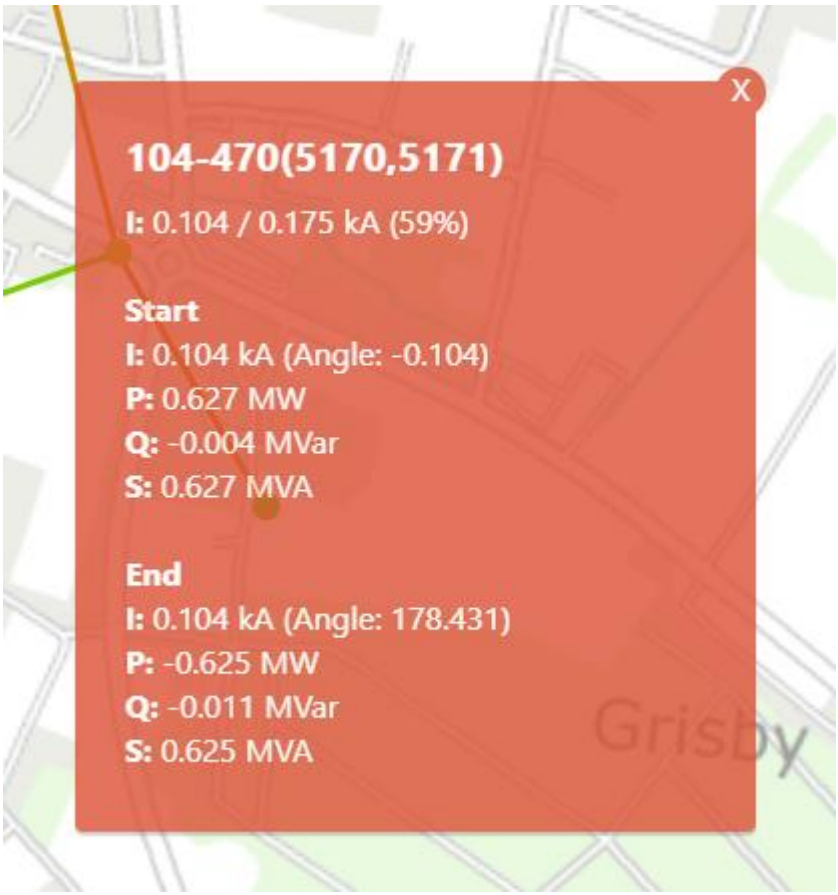

Figure 6: Information shown when clicking on a line

This shows information about:

- The IDs of the two transformers that the line connects.
- The load of the line by comparing the electric current running through it to its rating.
- The current, power, reactive power and admittance. Of each end of the line.

In the shown example on figure 6, the selected line has a significant load of 59% of it's rating of 0.175 kA.

Conclusion

With this tool Insero has developed a useful tool for the DSO to get an overview over the entire grid and loads on the grid. This tool can help to identify areas in the grid with a limited capacity, that might attention in the form of upgrades or use of flexibility. By providing this overview and together with existing tools, the DSO is able to make informed decisions regarding the operation of the grid.