



17TH ANNUAL
UK LIGHT RAIL
CONFERENCE

EFS: your light rail network in your hands

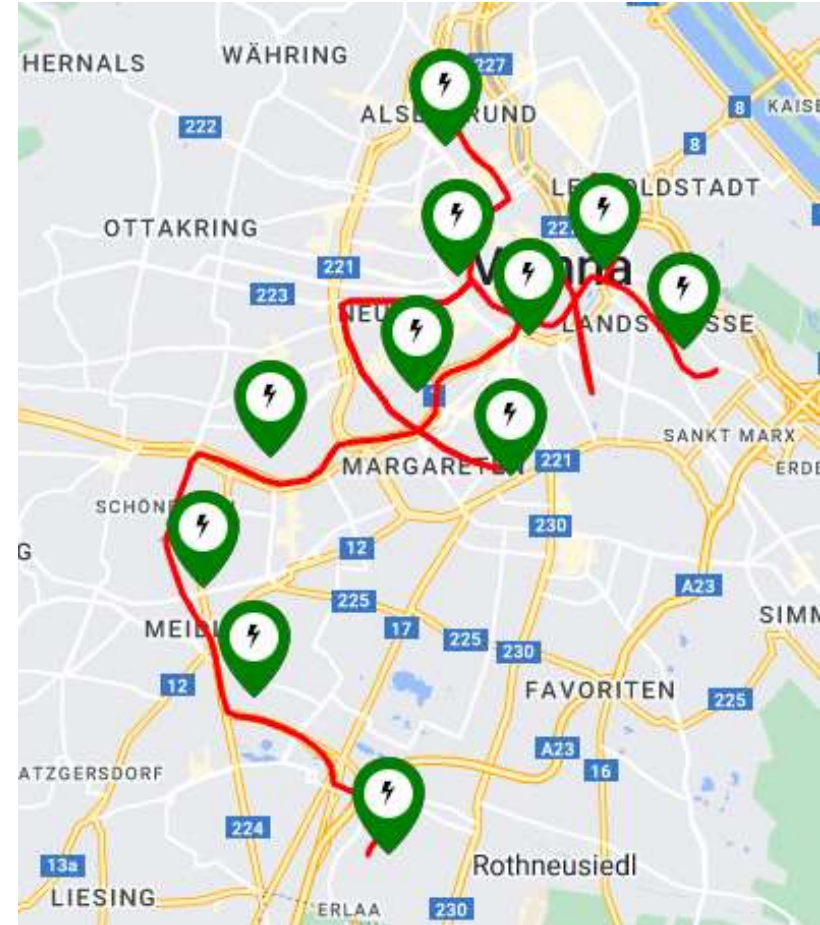
EFS

Energy Flow Simulation

Your light rail network in your
hands

Gerard Clariana

11.07.2023



Energy Flow Simulation

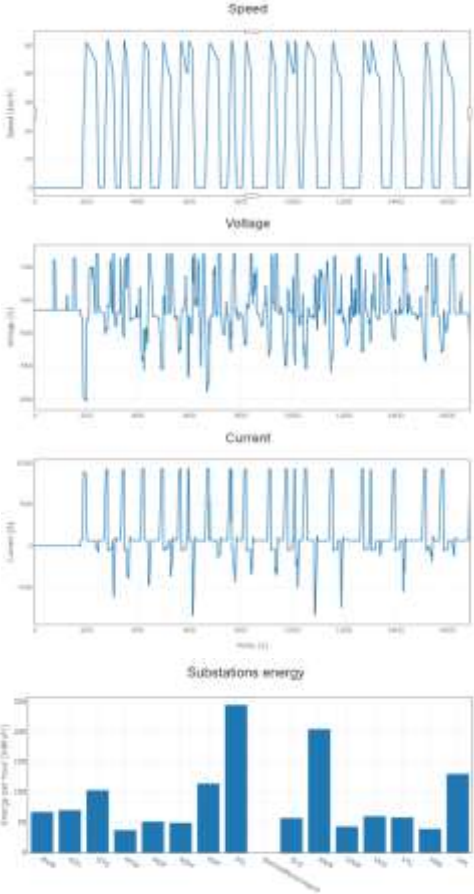
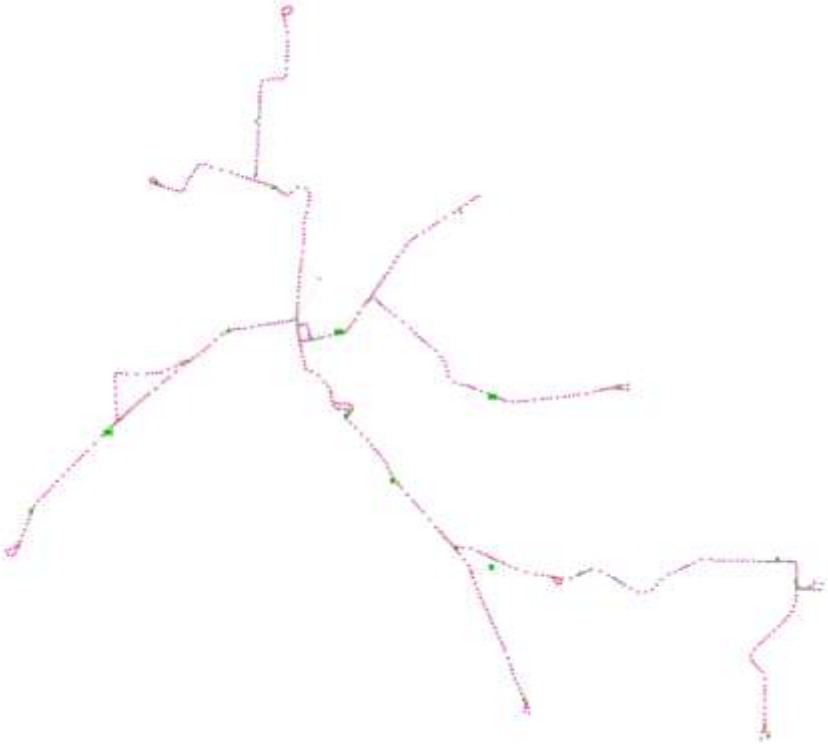
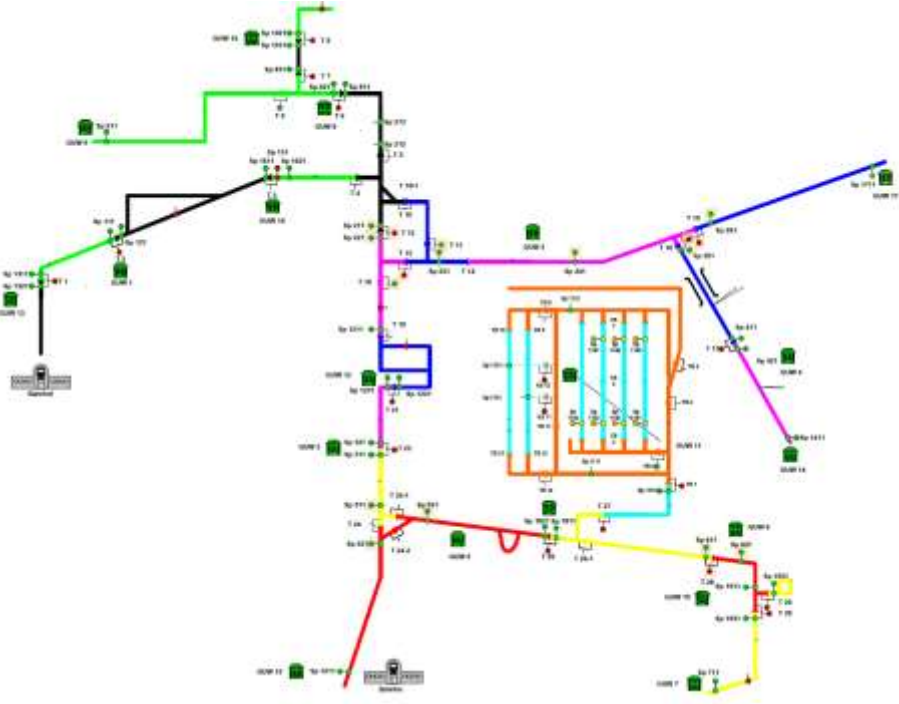
Tram network



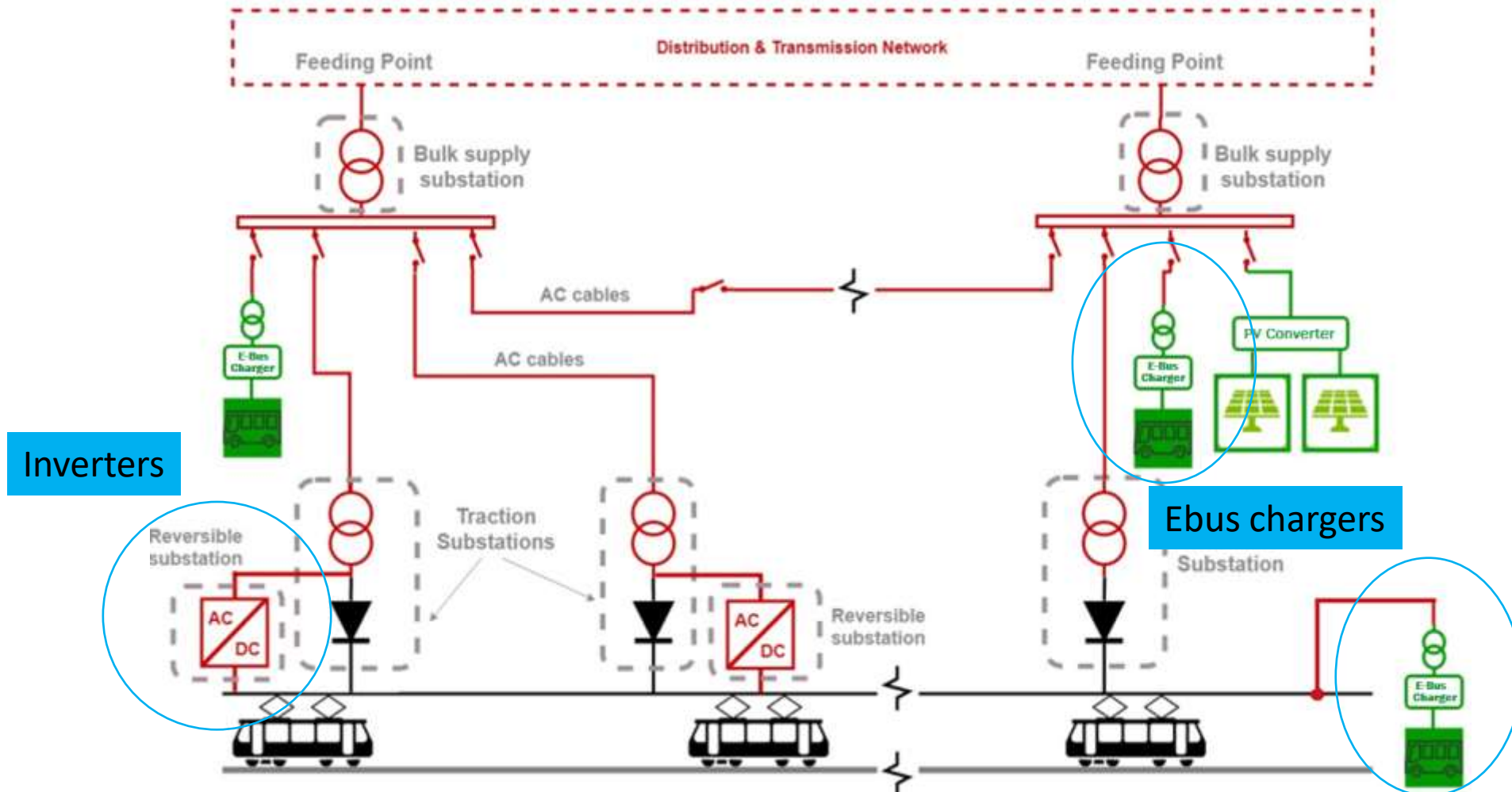
Digital model



Website



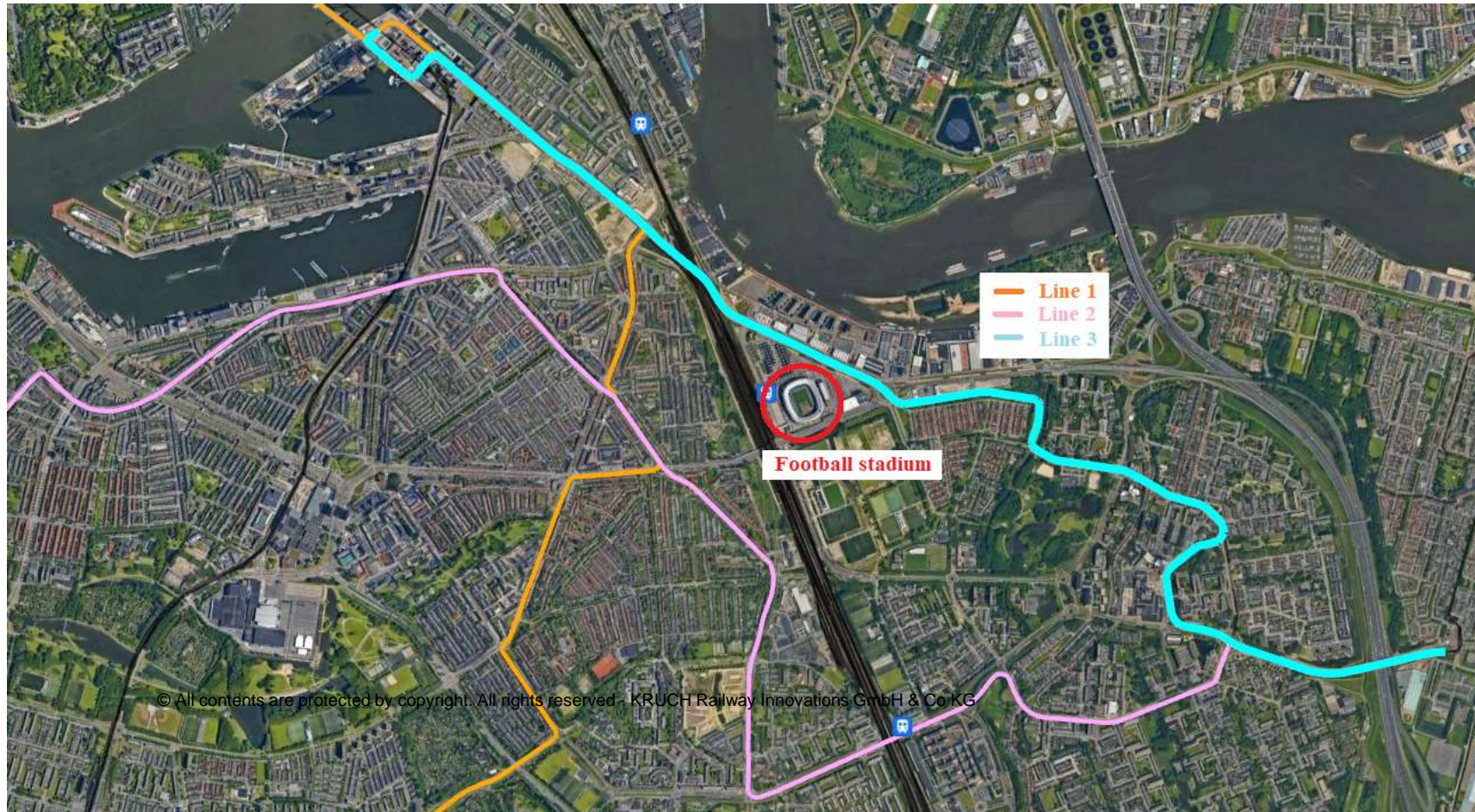
Energy optimization



Inverters

Ebus chargers

Frequency studies



Frequency studies

- Regular schedule: No football game

Name	Transformer loads	Positives feeders	OCS voltage	Rail-earth voltage	CW temperature	kWh/h purchased	Investment [k€]
Regular schedule: 10 min	Acceptable 	Acceptable 	Acceptable 	Acceptable 	Acceptable 	2980 	0 

Frequency studies

- Regular schedule: No football game
- Football game without investment

Name	Transformer loads	Positives feeders	OCS voltage	Rail-earth voltage	CW temperature	kWh/h purchased	Investment [k€]
Regular schedule: 10 min	Acceptable 	Acceptable 	Acceptable 	Acceptable 	Acceptable 	2980 	0 
Football game: 2.5 min	Not acceptable 	Acceptable 	Not acceptable 	Acceptable 	Acceptable 	3810 	0 

Frequency studies

Solutions

- 3 new substation → 3.6M€

Name	Transformer loads	Positives feeders	OCS voltage	Rail-earth voltage	CW temperature	kWh/h purchased	Investment [k€]
Regular schedule: 10 min	Acceptable 	Acceptable 	Acceptable 	Acceptable 	Acceptable 	2980 	0 
Football game: 2.5 min	Not acceptable 	Acceptable 	Not acceptable 	Acceptable 	Acceptable 	3810 	0 
Football game: 2.5 min + 3 extra subst.	Acceptable 	Acceptable 	Acceptable 	Acceptable 	Acceptable 	3780 	3600 

Frequency studies

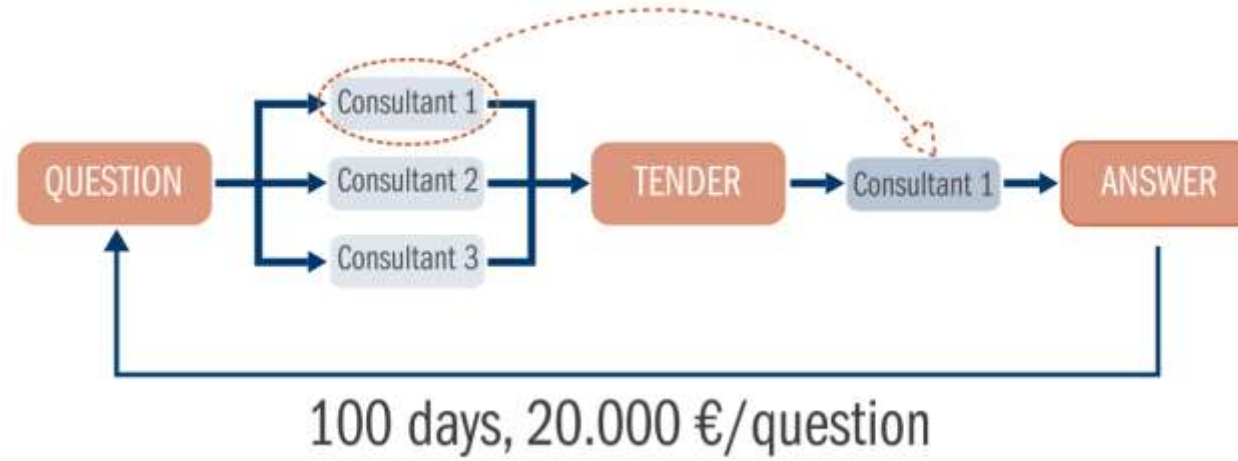
Solutions

- 3 new substation → 3.6M€
- 3 ESS (flywheel, battery or super cap) → 2.1M€

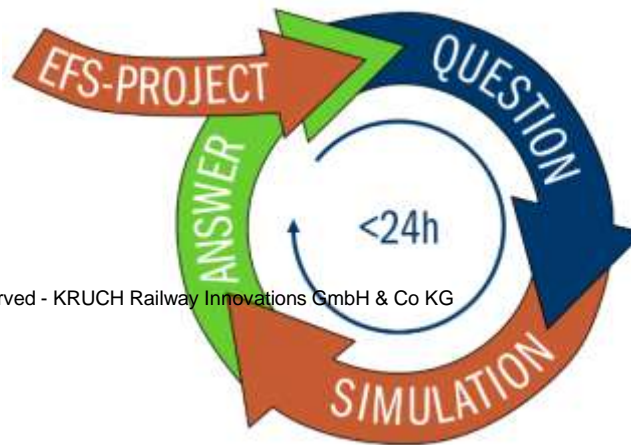
Name	Transformer loads	Positives feeders	OCS voltage	Rail-earth voltage	CW temperature	kWh/h purchased	Investment [k€]
Regular schedule: 10 min	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	2980	0
Football game: 2.5 min	Not acceptable	Acceptable	Not acceptable	Acceptable	Acceptable	3810	0
Football game: 2.5 min + 3 extra subst.	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	3780	3600
Football game: 2.5 min + 3 extra ESS	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	3480	2100

EFS approach

Traditional



With EFS



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User interface

EFS is an online platform that you can use on any device with your browser.

Simulation New Simulation RUN [Back to index](#)

INPUT DATA

General parameters

Name:

Email:

N°:

Simulation parameters

Duration of the simulation [h]:

Chopper voltage [V]:

Acceleration & braking:

Stopping time at the stations:

Investment [k€]:

Conductor parameters

Wear contact wire [%]:

Wear of third rail [%]:

Wear of the return rail [%]:

Temperature feeding [°C]:

Temperature OCS [°C]:

Temperature return rail [°C]:

VEHICLES

<input type="checkbox"/>	Name	Empty mass [Tn]	Rotating mass [Tn]	Passenger load [Tn]	Auxiliary power [kW]	Speed acceleration 1	Speed acceleration 2	Speed braking 1 [km/h]	Commands
<input type="checkbox"/>	Krucht	41.7	4.17	25	4.6	22	50	56	<input type="text"/> <input type="text"/>

Showing 1 to 1 of 1 entries

TIMETABLES

<input type="checkbox"/>	Line	Vehicle	Units per vehicle	Frequency [min]	Offset [min]	Passengers per vehicle [%]	Start time [min]	Commands
<input type="checkbox"/>	Line 1	Krucht	1	10	5	50	1	<input type="text"/> <input type="text"/>
<input type="checkbox"/>	Line 3	Krucht	1	10	7	50	5	<input type="text"/> <input type="text"/>

MAP

Elements map Results map



Legend

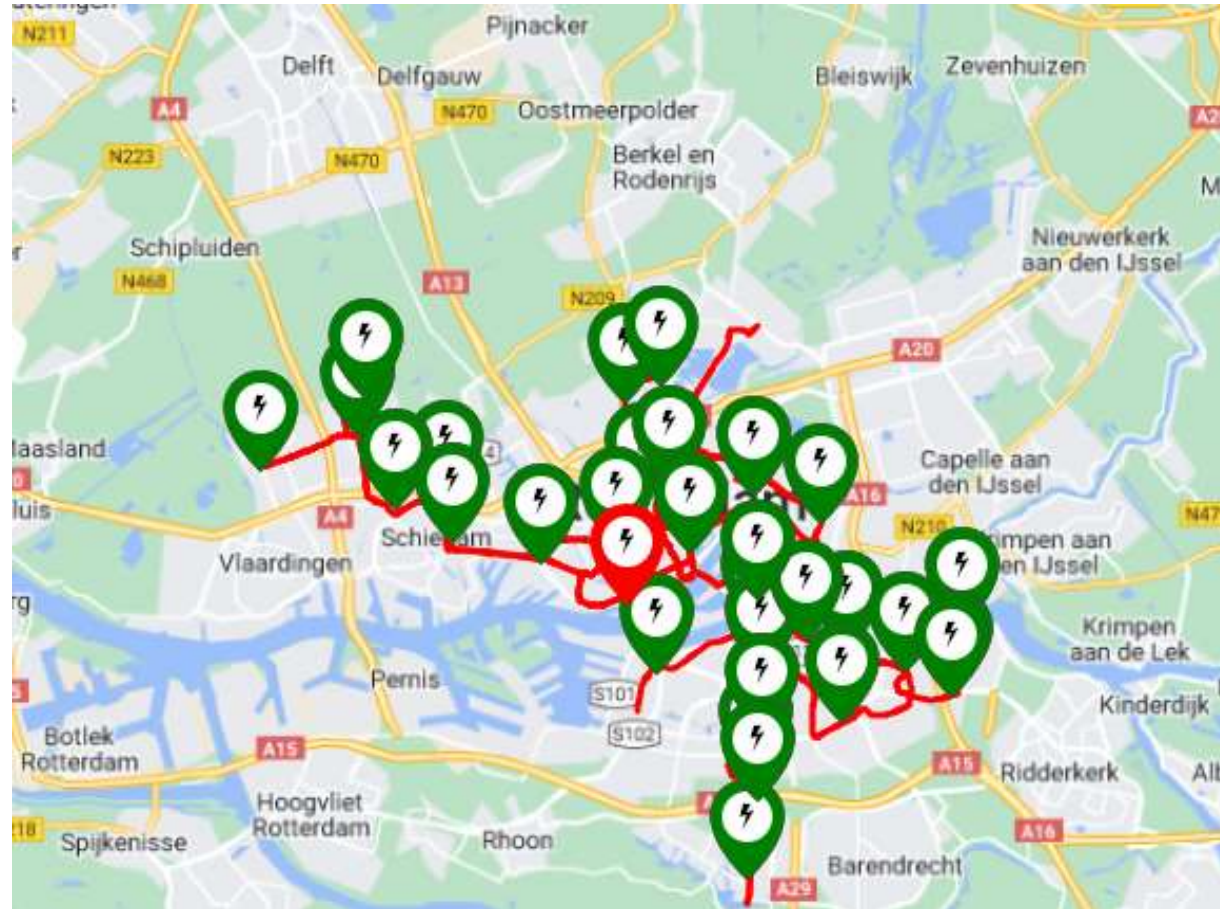
- Stations
- Translines
- Change image
- Pending lines
- Plan
- Block
- Trackpoint
- Parking point
- Parking Point OCS
- Vehicle with empty destination
- Vehicle with empty track
- Queue vehicle
- Stop

DATA TABLE

GRAPHICS

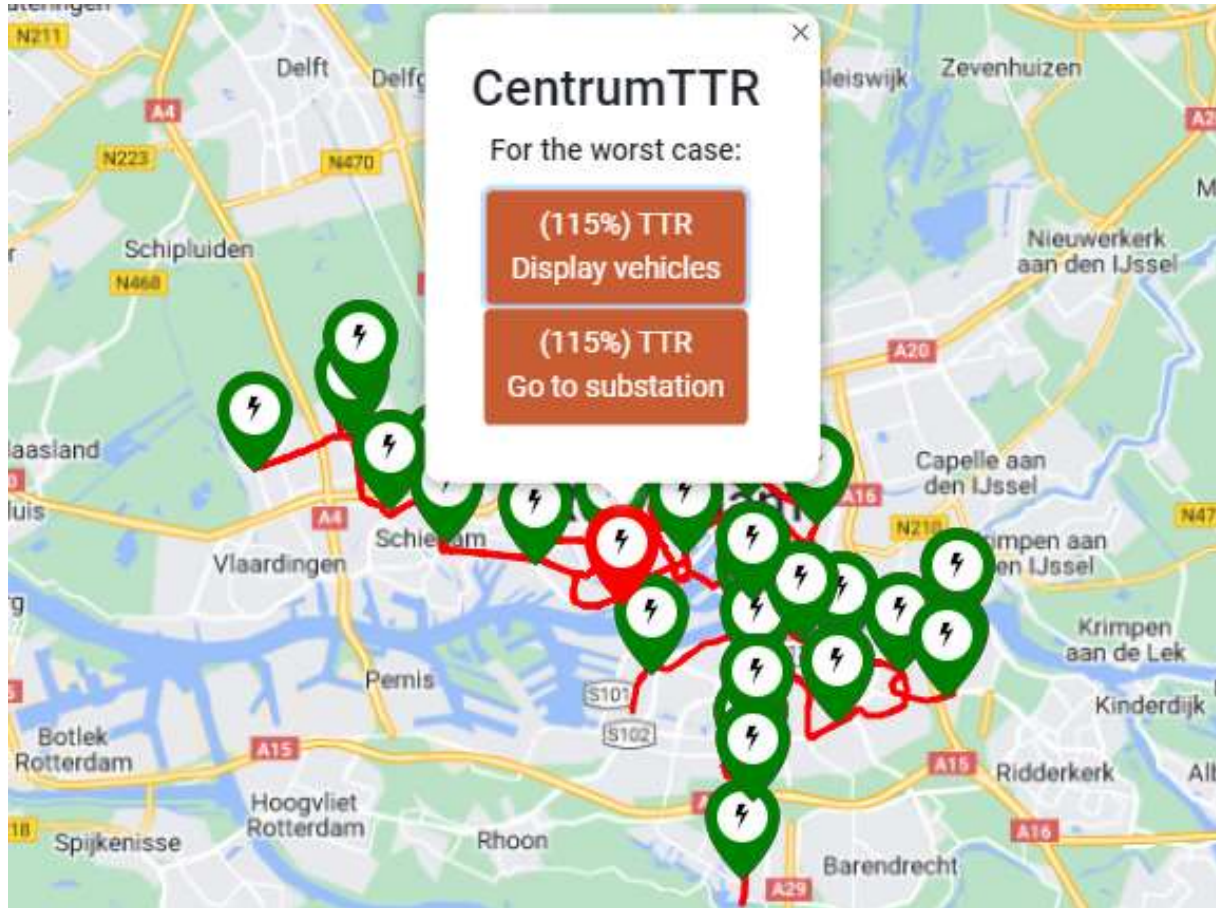
Results

- Substation overloads



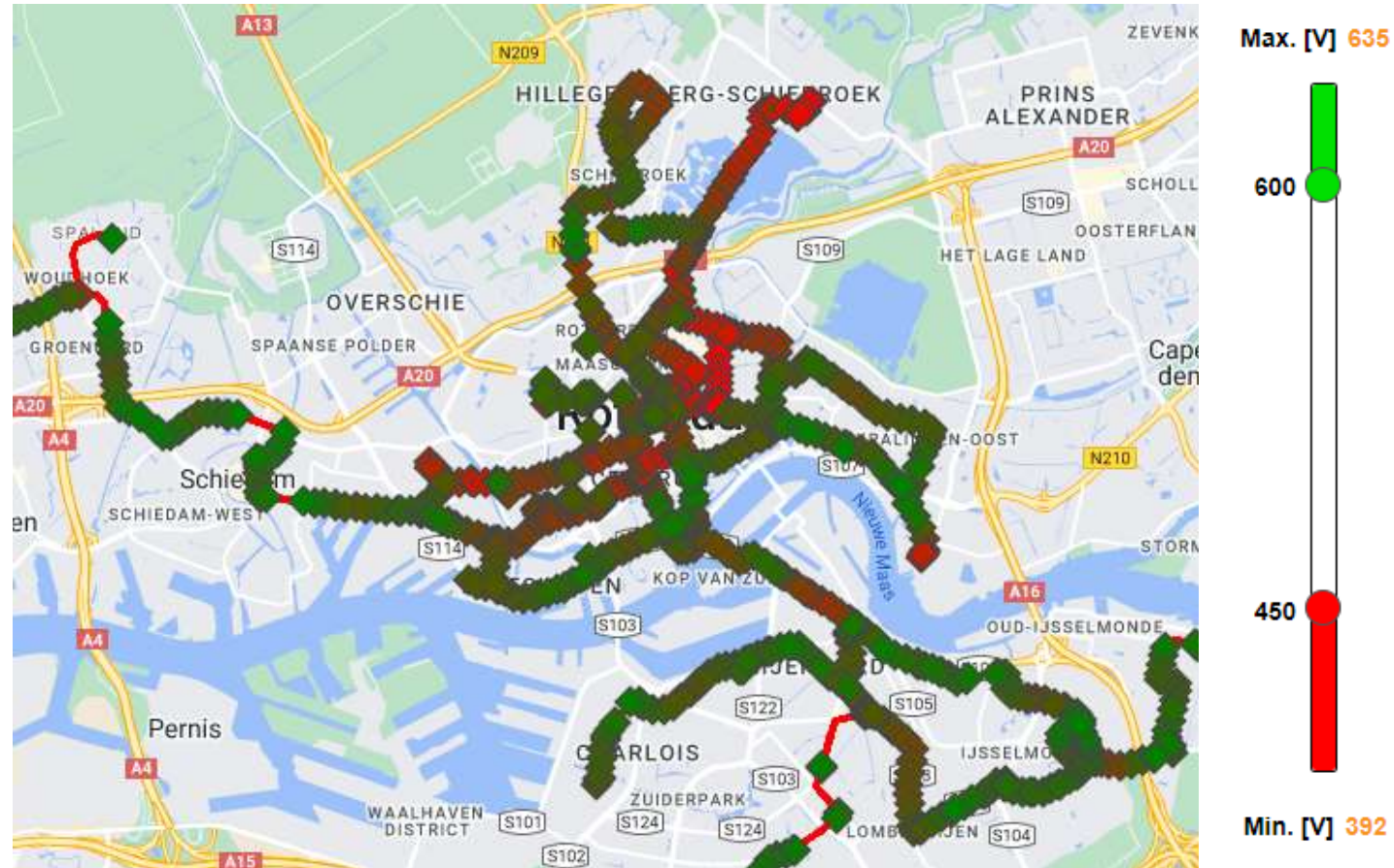
Results

- Substation overloads

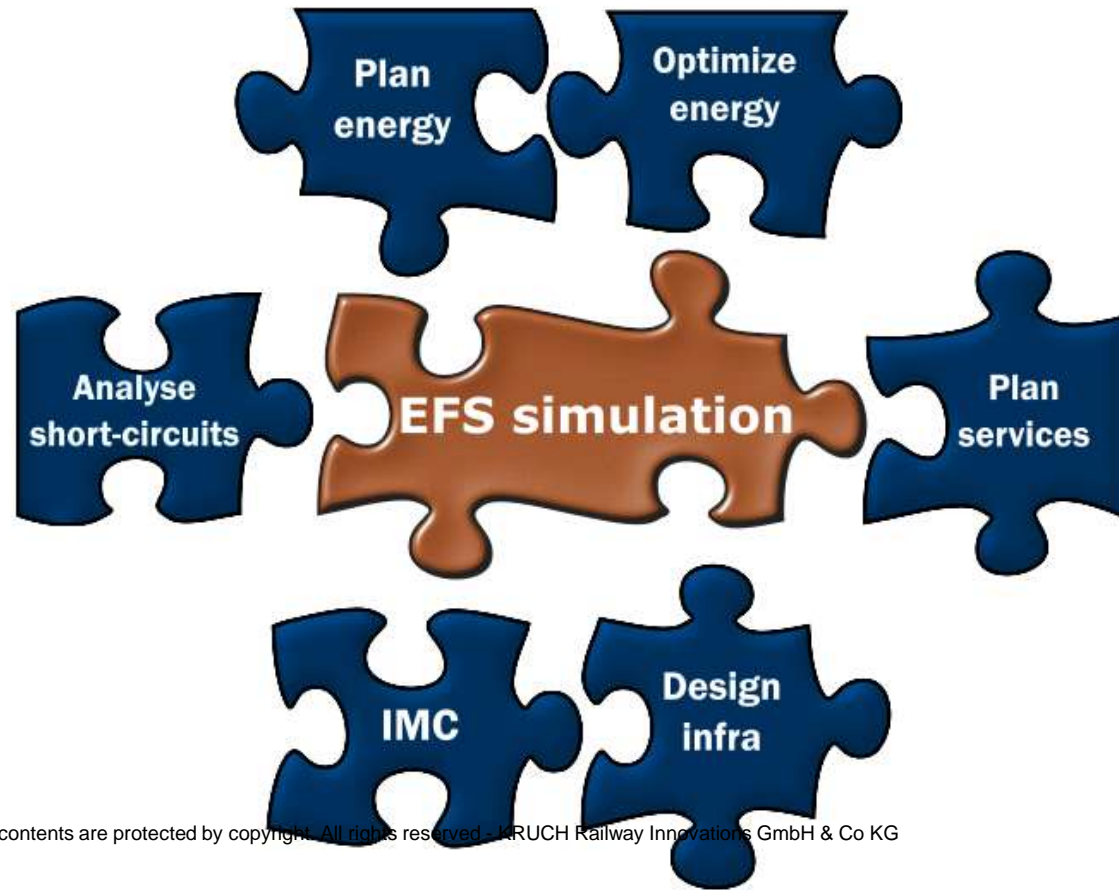


Results

- Hot spots on the network: OCS low voltage



Why a simulation tool



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References

Operators that already have their network in their hands



Thank you
for your attention

“The digitalisation of transportation systems is a need and owning your digital twin is a reality using EFS”

How can EFS help you?

Visit us at booth T in the exhibition hall for an EFS demonstration

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