

Gerald Clariana

Kruch Railway Innovations

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RAILWAY INNOVATIONS

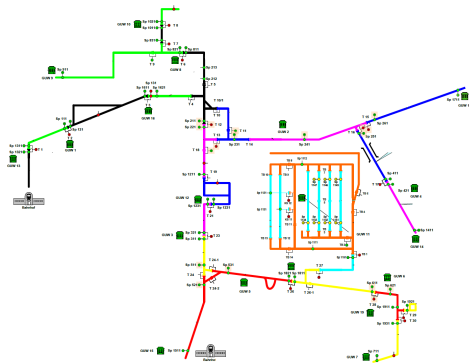
EFS: Energy Flow Simulation

Your light rail network in your hands

Energy Flow Simulation

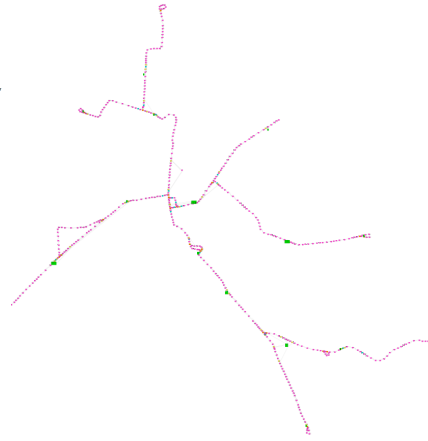
1

Railway network



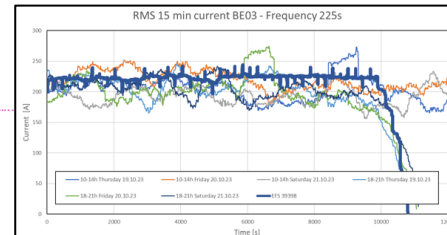
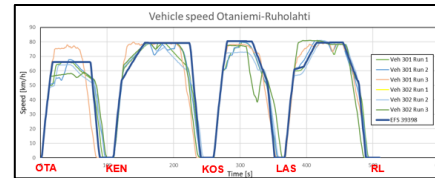
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Digital model



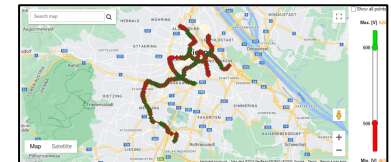
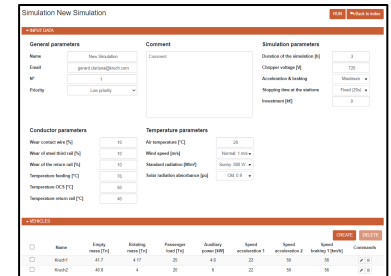
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Validation



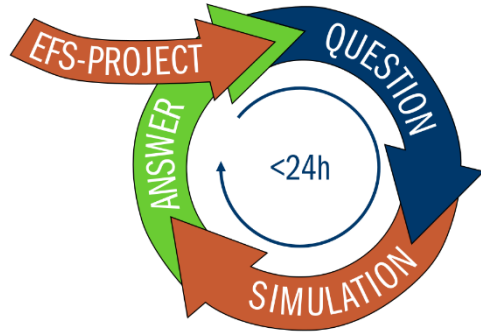
4

Cloud results

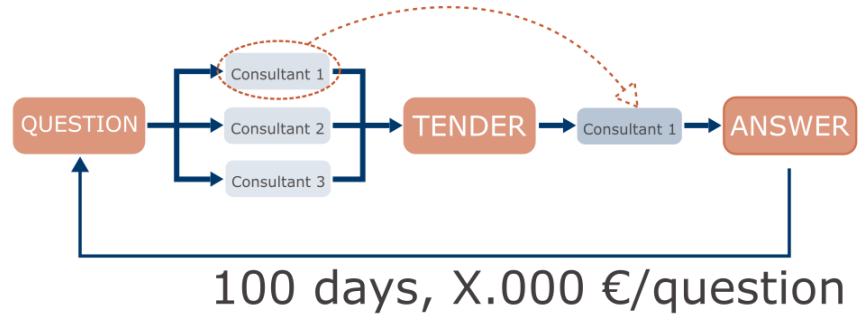


Features of EFS

Energy Flow Simulation



Traditional



User interface

Simulation New Simulation

RUN ← Back to index

INPUT DATA

General parameters

Name:

Email:

N°:

Priority:

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 steel third rail [%]:

Wear of the return rail [%]:

Temperature feeding [°C]:

Temperature OCS [°C]:

Temperature return rail [°C]:

VEHICLES

CREATE DELETE

<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"/>	Kruch1	41.7	4.17	25	4.6	22	50	56	<input type="text"/> <input type="text"/>
<input type="checkbox"/>	Kruch2	40.8	4	20	6	22	50	56	<input type="text"/> <input type="text"/>

Showing 1 to 2 of 2 entries

TIMETABLES

CREATE DELETE

User interface

Simulation New Simulation

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

INPUT DATA

General parameters	Simulation parameters	Conductor parameters
Name: <input type="text" value="New Simulation"/>	Duration of the simulation [h]: <input type="text" value="3"/>	Wear contact wire [%]: <input type="text" value="10"/>
Email: <input type="text" value="ferran.rovira@kruch.com"/>	Chopper voltage [V]: <input type="text" value="720"/>	Wear of steel third rail [%]: <input type="text" value="10"/>
N°: <input type="text" value="1"/>	Acceleration & braking: <input type="text" value="Maximum"/>	Wear of the return rail [%]: <input type="text" value="10"/>
Priority: <input type="text" value="Low priority"/>	Stopping time at the stations: <input type="text" value="Fixed (20s)"/>	Temperature feeding [°C]: <input type="text" value="70"/>
	Investment [k€]: <input type="text" value="0"/>	Temperature OCS [°C]: <input type="text" value="50"/>
		Temperature return rail [°C]: <input type="text" value="40"/>

VEHICLES

[CREATE](#) [DELETE](#)

<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"/>	Kruch1	41.7	4.17	25	4.6	22	50	56	<input type="text"/> <input type="text"/>
<input type="checkbox"/>	Kruch2	40.8	4	20	6	22	50	56	<input type="text"/> <input type="text"/>

Showing 1 to 2 of 2 entries

TIMETABLES

[CREATE](#) [DELETE](#)

<input type="checkbox"/>	Line	Vehicle	Units per vehicle	Frequency [min]	Offset [min]	Passengers per vehicle [%]	Start time [min]	Commands
<input type="checkbox"/>	Line 1	Kruch1	1	10	5	50	1	<input type="text"/> <input type="text"/>
<input type="checkbox"/>	Line 2	Kruch2	1	10	5	80	7	<input type="text"/> <input type="text"/>
<input type="checkbox"/>	Line 3	Kruch1	1	10	7	50	5	<input type="text"/> <input type="text"/>

User interface

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

INPUT DATA

General parameters

Name:

Email:

N°:

Priority:

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 steel 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"/>	Kruch1	41.7	4.17	25	4.6	22	50	56	<input type="text" value=""/>
<input type="checkbox"/>	Kruch2	40.8	4	20	6	22	50	56	<input type="text" value=""/>

Showing 1 to 2 of 2 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	Kruch1	1	10	5	50	1	<input type="text" value=""/>
<input type="checkbox"/>	Line 2	Kruch2	1	10	5	80	7	<input type="text" value=""/>
<input type="checkbox"/>	Line 3	Kruch1	1	10	7	50	5	<input type="text" value=""/>

Vehicle Create

Name	<input type="text" value="New"/>
Empty mass [Tn]	<input type="text" value="41.2"/>
Rotating mass [Tn]	<input type="text" value="4"/>
Passenger load [Tn]	<input type="text" value="13"/>
Auxiliary power [kW]	<input type="text" value="6"/>
Speed acceleration 1 [km/h]	<input type="text" value="20"/>
Speed acceleration 2 [km/h]	<input type="text" value="50"/>
Speed braking 1 [km/h]	<input type="text" value="56"/>
Speed braking 2 [km/h]	<input type="text" value="63"/>
Max. traction power [kW]	<input type="text" value="700"/>
Max. braking power [kW]	<input type="text" value="1550"/>
Max. traction current [A]	<input type="text" value="700"/>
Max. heating power [kW]	<input type="text" value="40"/>
HVAC percentage [%]	<input type="text" value="30"/>
Coef. A resistance force [N/kg]	<input type="text" value="0.045"/>
Coef. B resistance force [N/(kg m/s)]	<input type="text" value="0.0022"/>
Coef. C resistance force [N/(m/s)]	<input type="text" value="0.36"/>
Efficiency accelerating [pu]	<input type="text" value="0.81"/>
Efficiency braking [pu]	<input type="text" value="0.81"/>
Acceleration [m/s²]	<input type="text" value="1.3"/>
Braking [m/s²]	<input type="text" value="1.2"/>

Save
Cancel

User interface

Simulation New Simulation RUN Back to index

▼ INPUT DATA

General parameters

Name:

Email:

N°:

Priority:

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 steel third rail [%]:

Wear of the return rail [%]:

Temperature feeding [°C]:

Temperature OCS [°C]:

Temperature return rail [°C]:

▲ VEHICLES CREATE DELETE

<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"/>	Kruch1	41.7	4.17	25	4.6	22	50	56	<input type="text"/> <input type="text"/>
<input type="checkbox"/>	Kruch2	40.8	4	20	6	22	50	56	<input type="text"/> <input type="text"/>

Showing 1 to 2 of 2 entries

▲ TIMETABLES CREATE DELETE

<input type="checkbox"/>	Line	Vehicle	Units per vehicle	Frequency [min]	Offset [min]	Passengers per vehicle [%]	Start time [min]	Commands
<input type="checkbox"/>	Line 1	Kruch1	1	10	5	50	1	<input type="text"/> <input type="text"/>
<input type="checkbox"/>	Line 2	Kruch2	1	10	5	80	7	<input type="text"/> <input type="text"/>
<input type="checkbox"/>	Line 3	Kruch1	1	10	7	50	5	<input type="text"/> <input type="text"/>

User interface

Simulation New Simulation RUN Back to index

INPUT DATA

General parameters

Name:

Email:

N°:

Priority:

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 steel third rail [%]:

Wear of the return rail [%]:

Temperature feeding [°C]:

Temperature OCS [°C]:

Temperature return rail [°C]:

VEHICLES

CREATE DELETE

<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"/>	Kruch1	41.7	4.17	25	4.6	22	50	56	<input type="text" value=""/>
<input type="checkbox"/>	Kruch2	40.8	4	20	6	22	50	56	<input type="text" value=""/>

Showing 1 to 2 of 2 entries

TIMETABLES

CREATE DELETE

<input type="checkbox"/>	Line	Vehicle	Units per vehicle	Frequency [min]	Offset [min]	Passengers per vehicle [%]	Start time [min]	Commands
<input type="checkbox"/>	Line 1	Kruch1	1	10	5	50	1	<input type="text" value=""/>
<input type="checkbox"/>	Line 2	Kruch2	1	10	5	80	7	<input type="text" value=""/>
<input type="checkbox"/>	Line 3	Kruch1	1	10	7	50	5	<input type="text" value=""/>

Timetables

Edit

Line:

Vehicle:

Units per vehicle:

Frequency [min]:

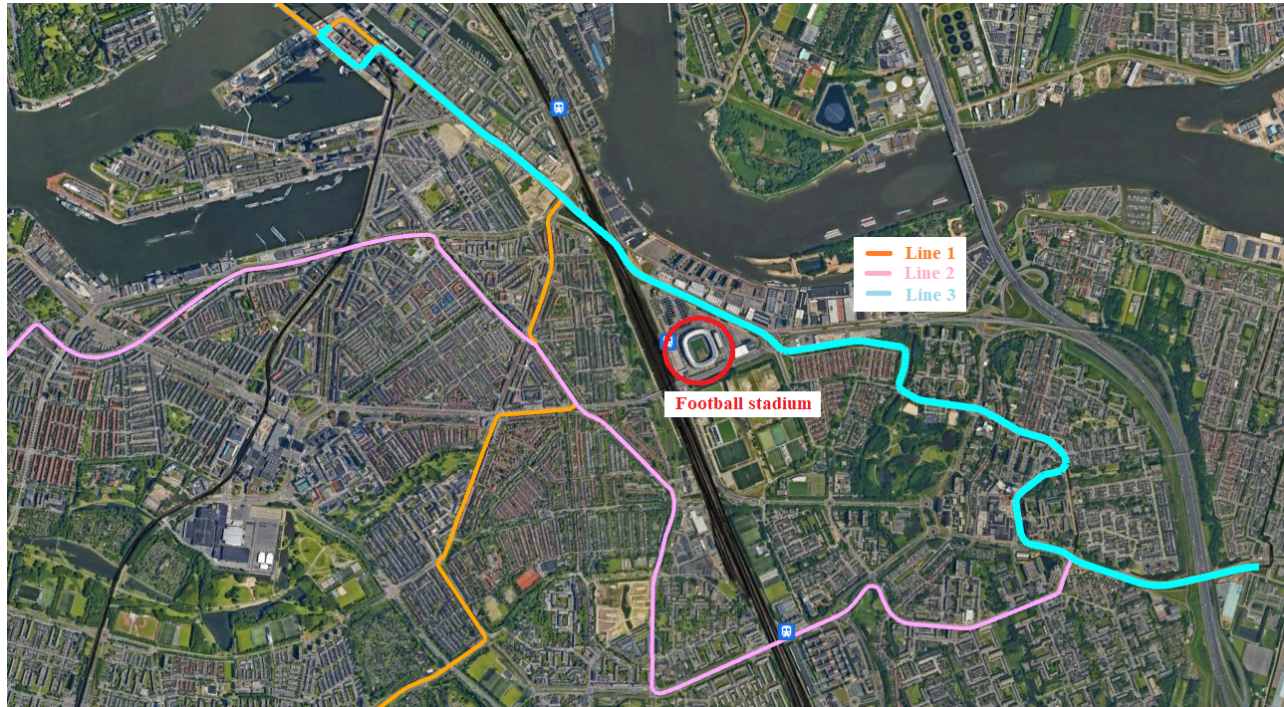
Offset [min]:

Passengers per vehicle [%]:

Start time [min]:








Save Cancel

User case 1: Football game

















User case 1: Football game

- 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 






















User case 1: Football game

- 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 





























User case 1: Football game

- 3 new substation → 3.6 M€

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 

User case 1: Football game

- 3 new substation → 3.6 M€
- 3 batteries (700 kWh) → 2.1 M€

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 

User case 1: Football game

- 3 new substation → 3.6 M€
- 3 batteries (700 kWh) → 2.1 M€

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
Football game: 4 min	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	3644	0

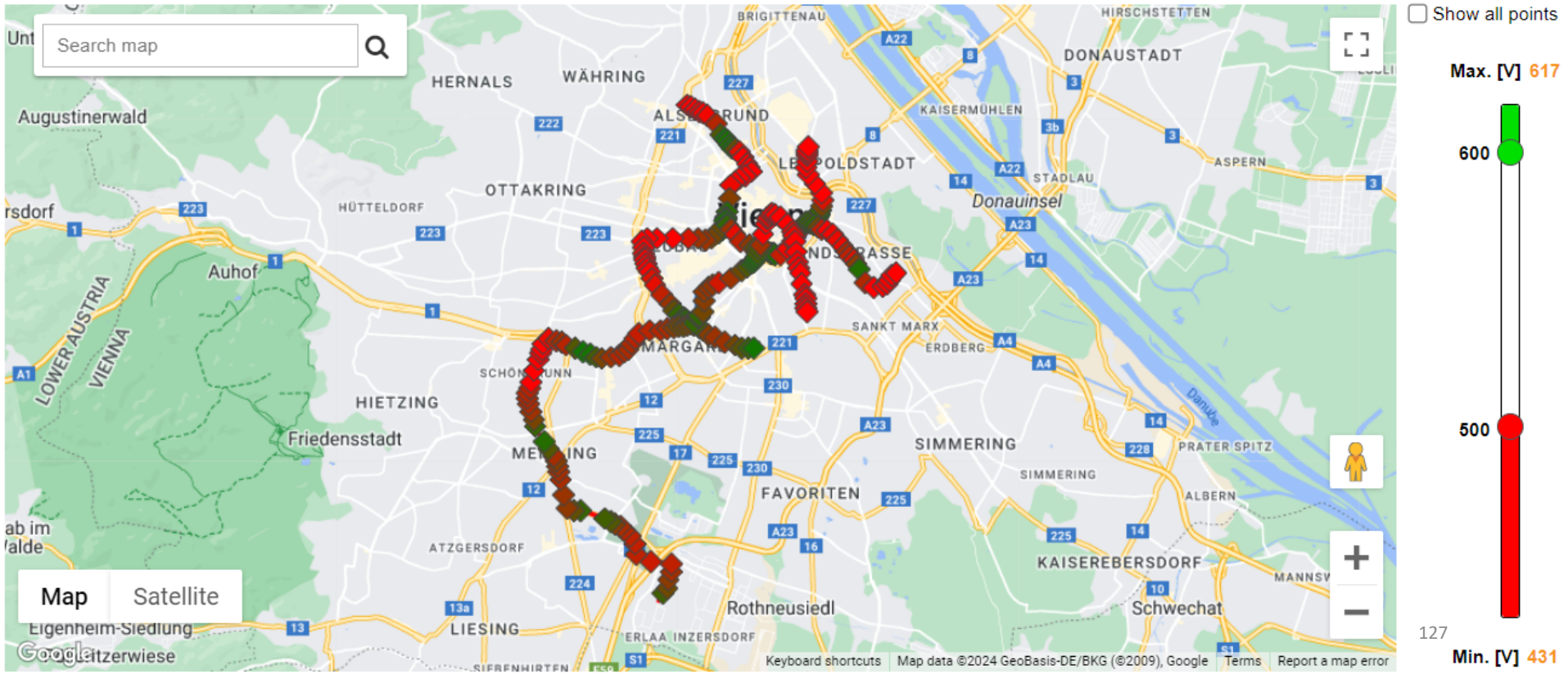
User case 2: New services



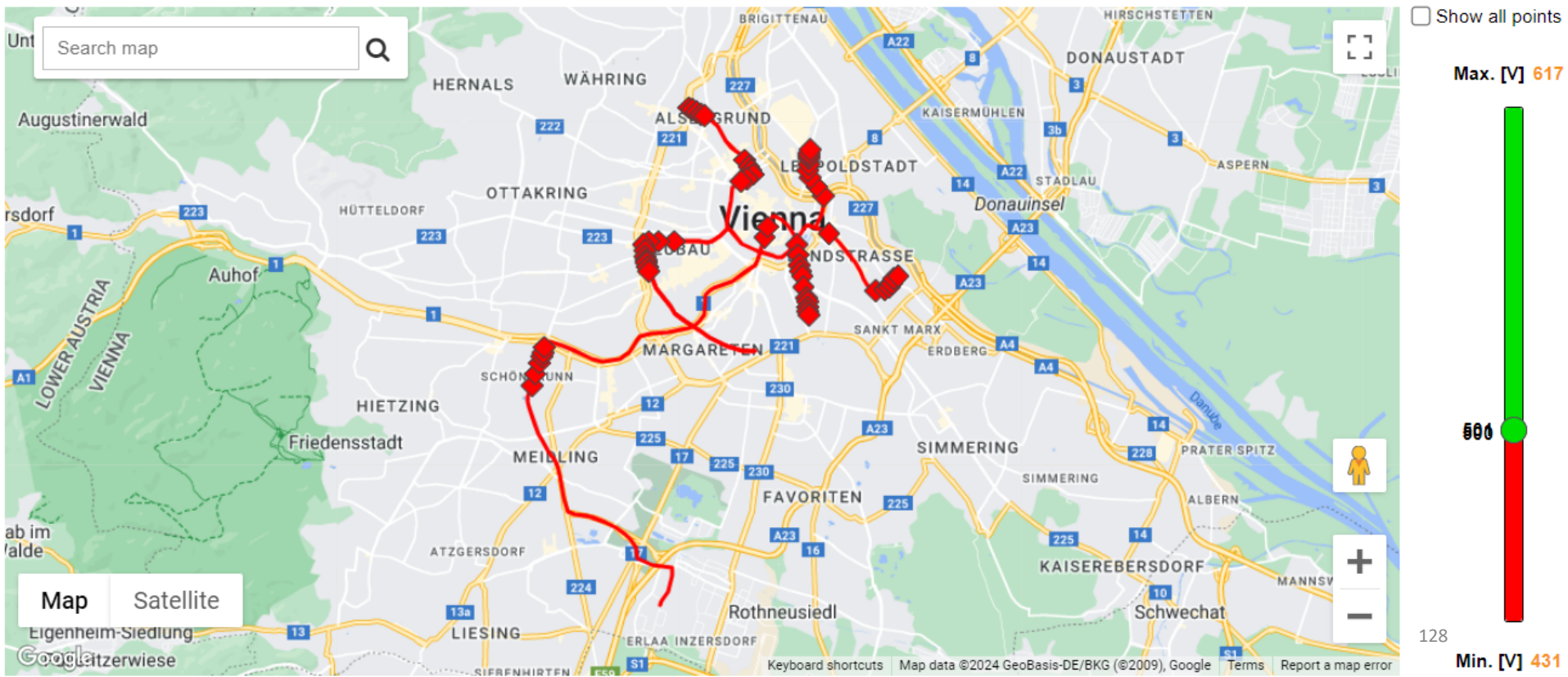
User case 2: New services









User case 2: New services















User case 2: New services





















User case 2: New services

Id	Name	Transformer loads	OCS & 3rd rail voltage	Rail-earth voltage	Positives feeders	Negative feeders	Investment [k€]
39016	N scenario - 10 min - CW100	Not acceptable 	Not acceptable 	Acceptable 	Acceptable 	Acceptable 	0 

























User case 2: New services

Id	Name	Transformer loads	OCS & 3rd rail voltage	Rail-earth voltage	Positives feeders	Negative feeders	Investment [k€]
39016	N scenario - 10 min - CW100	Not acceptable 	Not acceptable 	Acceptable 	Acceptable 	Acceptable 	0 
39024	N scenario - 10 min - CW100+MW150	Not acceptable 	Not acceptable 	Acceptable 	Acceptable 	Acceptable 	1000 

























User case 2: New services

Id	Name	Transformer loads	OCS & 3rd rail voltage	Rail-earth voltage	Positives feeders	Negative feeders	Investment [k€]
39016	N scenario - 10 min - CW100	Not acceptable 	Not acceptable 	Acceptable 	Acceptable 	Acceptable 	0 
39024	N scenario - 10 min - CW100+MW150	Not acceptable 	Not acceptable 	Acceptable 	Acceptable 	Acceptable 	1000 
39025	N scenario - 10 min - CW100+MW150 + I&G 2xPnominal	Acceptable 	Not acceptable 	Acceptable 	Acceptable 	Acceptable 	3000 

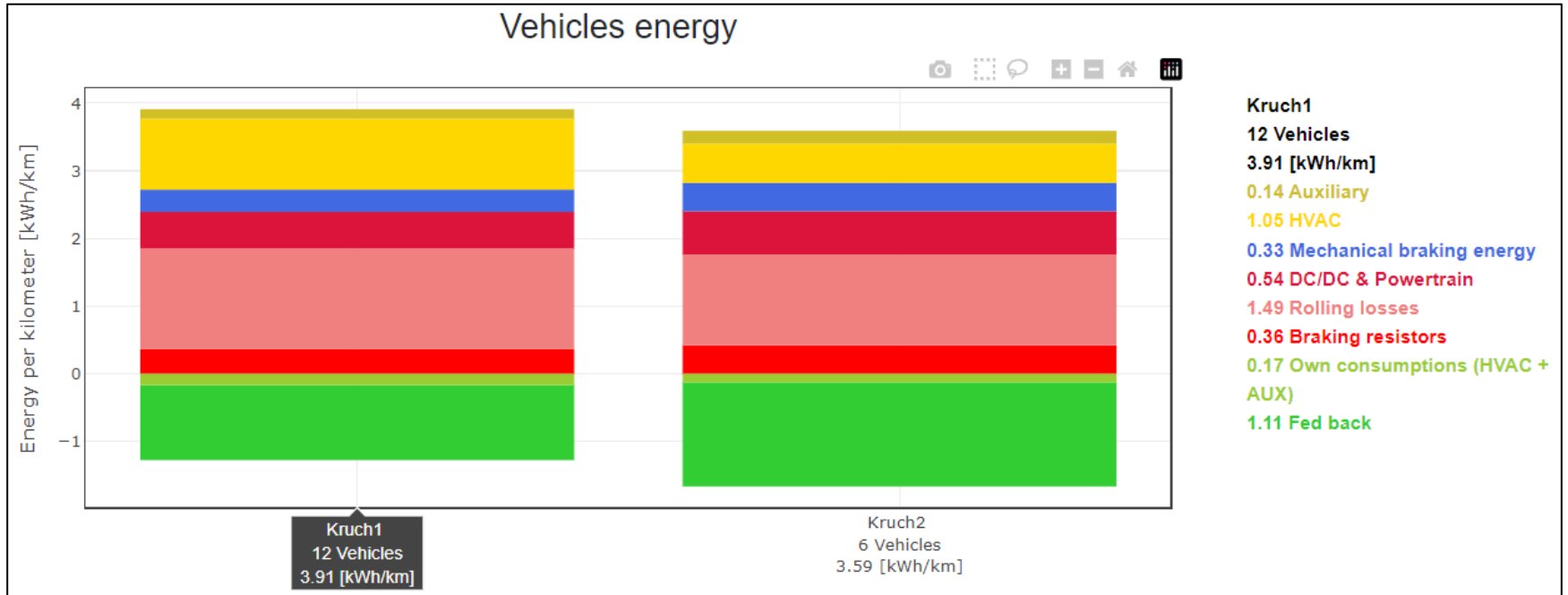
User case 2: New services

Id	Name	Transformer loads	OCS & 3rd rail voltage	Rail-earth voltage	Positives feeders	Negative feeders	Investment [k€]
39016	N scenario - 10 min - CW100	Not acceptable 	Not acceptable 	Acceptable 	Acceptable 	Acceptable 	0 
39024	N scenario - 10 min - CW100+MW150	Not acceptable 	Not acceptable 	Acceptable 	Acceptable 	Acceptable 	1000 
39025	N scenario - 10 min - CW100+MW150 + I&G 2xPnominal	Acceptable 	Not acceptable 	Acceptable 	Acceptable 	Acceptable 	3000 
39030	N scenario - 10 min - CW100+2xMW150 + I&G 2xP nominal	Acceptable 	Acceptable 	Acceptable 	Acceptable 	Acceptable 	5000 

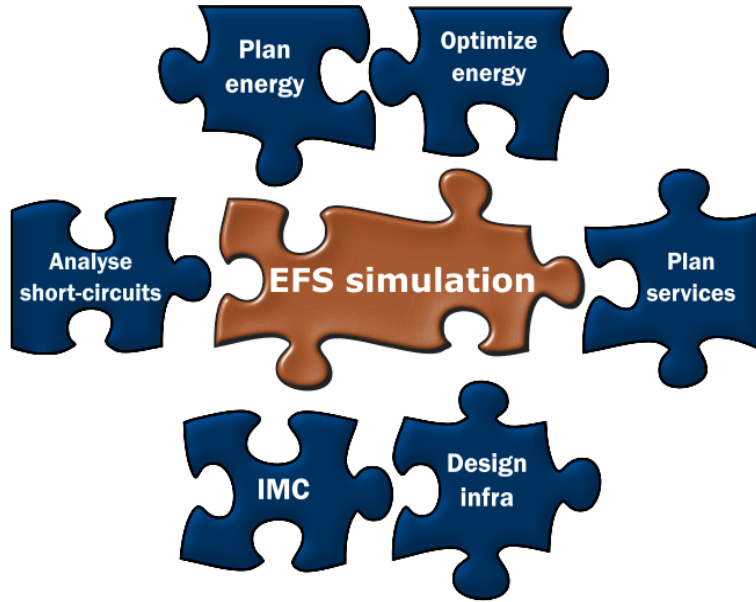
User case 2: New services

Id	Name	Transformer loads	OCS & 3rd rail voltage	Rail-earth voltage	Positives feeders	Negative feeders	Investment [k€]
39016	N scenario - 10 min - CW100	Not acceptable 	Not acceptable 	Acceptable 	Acceptable 	Acceptable 	0 
39024	N scenario - 10 min - CW100+MW150	Not acceptable 	Not acceptable 	Acceptable 	Acceptable 	Acceptable 	1000 
39025	N scenario - 10 min - CW100+MW150 + I&G 2xPnominal	Acceptable 	Not acceptable 	Acceptable 	Acceptable 	Acceptable 	3000 
39030	N scenario - 10 min - CW100+2xMW150 + I&G 2xP nominal	Acceptable 	Acceptable 	Acceptable 	Acceptable 	Acceptable 	5000 

User case 3: Energy vehicle comparison



Why a simulation tool?



References



Thank you for your attention

How can EFS help you?

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

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