



Presentation

# Electric Bus Fleet Management

[genesismobo.com](http://genesismobo.com)

## Map Module

Topology, location of chargers on a map, route of vehicles.

- real-time feedback

## Telemetry Module

Collecting and analyzing data from vehicles and chargers.

- data collecting
- alarms
- analysis

## VDV 261

We meet the standard, the connection of devices in the vehicle with external applications.

## OCPP

Data and specifications from chargers. Data management, intelligent algorithm, charge optimization.

- chargers management
- schedule



## Schedule Module

Passenger transport planning. Course schedule, brigade planning etc.

- planning
- schedule
- printouts

# Management System (structure)



# WEB platform

Hi-tech system - Client Server

- remote access
- multi-user access
- data security



# Planning

## realization of transport reports and analyses

Based on connections graph and statistical data.

- Planner
- Optimizer

Control and verification. Ability to fast respond in emergency situations.

- Telemetry
- Map and line graph
- Alarm system

Collation of telemetry parameters - e.g. batteries' SOC, average electricity consumption.

- Telemetry reports
- Transport realization reports
- Aggregated reports generator

1. PLANNING

2. REALIZATION

3. REPORTS

Maintaining the continuity of passenger transportation, costs optimization.

# Planning

1



1

Possibility to check if a given vehicle is able to complete a given transport task considering chargers in the city and at the depot.

2

Counting actual consumption on a base of:

- connections graphs of schedule (connection geometry)
- average speed of previous completed trips.



## TOOLS:

**ELECTRIC TRANSPORT PLANNER**

**ELECTRIC TRANSPORT OPTIMIZER**

# 1

# Electric transport planner

Enables effective schedule planning with electric fleet. Takes into consideration electric chargers (e.g. charging power, charging time, location), schedules and electric vehicles (including electric battery parameters, battery consumption indicator).

E-Bus Simulation
Admin [Log out](#)

New Simulation - Step 2 of 2

New Simulation  
**Simulation 01**

Lines: 123 234 + Add a line

**BRIGADES, GLOBAL SETTINGS:**

Vehicles  
Solaris\_U18E\_2017 →

Initial State (%)  Battery Minimum (%)  Battery Maximum(%)  On Depot Loss(%)  Maneuver Time (Min.)  →

**BRIGADES, MANUAL SETTINGS:**

Brigade	Service	Depot	Class	Electric Profile	Vehicle	Initial Battery Status(%)	Battery Minimum (%)	Battery Maximum (%)	On Depot Loss (%)	Maneuver Time
1	04:59 - 22:03	Z1	Gn	Solaris_U18E_2017	r100	90	40	90	1	1
2	06:34 - 00:32	Z1	Gn	Solaris_U18E_2017	r101	90	40	90	1	1
3	06:05 - 00:02	Z1	Gn	Solaris_U18E_2017	r102	90	40	90	1	1
04	04:46 - 20:16	Z1	Gn	Solaris_U18E_2017	r103	90	40	90	1	1
05	06:24 - 19:31	Z1	Gn	Solaris_U18E_2017	r104	90	40	90	1	1
06	04:26 - 18:51	Z1	Gn	Solaris_U18E_2017	r105	90	40	90	1	1

**CHARGING POINTS** POINT 1 POINT 2

+ ADD CHARGING POINT

Power[Kw]	Maneuver Time	Min. Charging Time[Min.]	Voltage[V]	Lines	Delete
400	1	4	686,4	<input checked="" type="checkbox"/> 123 <input checked="" type="checkbox"/> 234	⊗
400	1	4	686,4	<input type="checkbox"/> 123 <input checked="" type="checkbox"/> 234	⊗

CANCEL
GO TO STEP 3

# 1

# Planner - simulation results

The planner generates a work schedule for electric vehicles that extends the notion of a schedule by adding breaks due to the need for charging.

Admin Wyloguj
E-Bus Simulation

Simulation results

Name: **Test 1**

Simulation date: **2018-08-09**      Brigades operated by agents: **No**      Status: **successfully completed**

Algorithm: **maximum battery level**      Charge length modification: **None**      Extension of the last stop: **No**

Line: **234**

Brigade	Depot	Service Time	Electric Profile	Vehicle	Notes	Details
1	Z1	5:30 - 22:20	U 12	9997	-	<a href="#">show</a>
2	Z1	7:30 - 23:00	U 12	9998	-	<a href="#">show</a>
3	Z1	7:30 - 23:00	U 12	9996	-	<a href="#">show</a>

**Vehicle Details v988**

Battery minimum: 15%     
 Battery maximum: 100%     
 On depot loss: 2%     
 Maneuver time: 1 min.

**State of charge**

**The course of realization**

Time	Line/Brigade	State Of Charge	Place	Incident
03:42	234/1	98.00%	Place 1	Departure
03:49	234/1	96.07%	Place1	Arrival
03:49	234/1	96.07%	Place1	Not charging, max. battery level exceeded.
03:53	234/1	96.07%	Place1	Departure
04:28	234/1	84.98%	Place1	Arrival
04:28	234/1	84.98%	Place1	Not charging, no charger on a marginal stop.

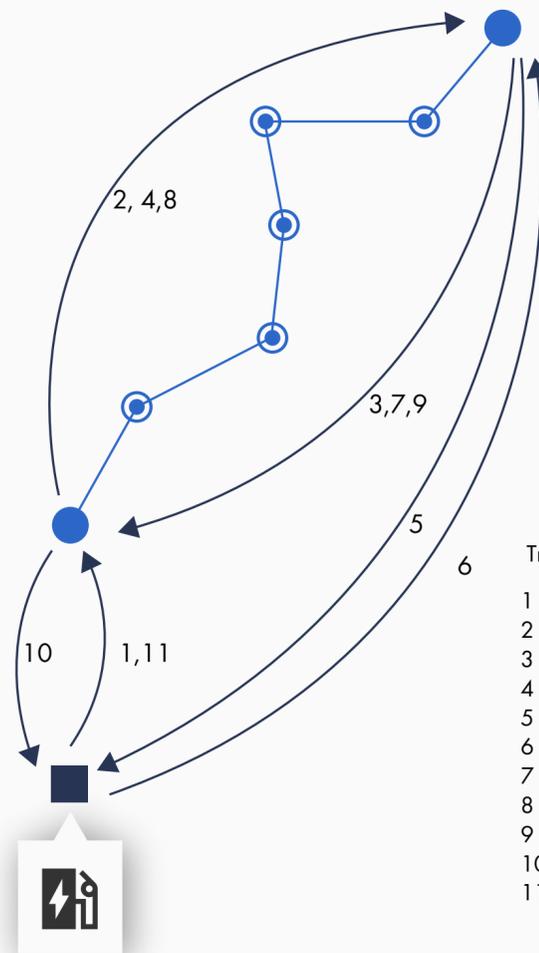
Eksport do PDF      Eksport do CSV

# Planning

## Electric transport optimizer

Additionally, it minimizes the time, or vehicle-kilometers, required to execute the schedule so that the cost of execution using electric fleet is as low as possible. The optimizer is applicable when the target customer does not have chargers at marginal stops, but only at the depots. At that time the cost of trips and accesses begins to be significant to the cost estimate associated with the schedule execution.

Example schema 1

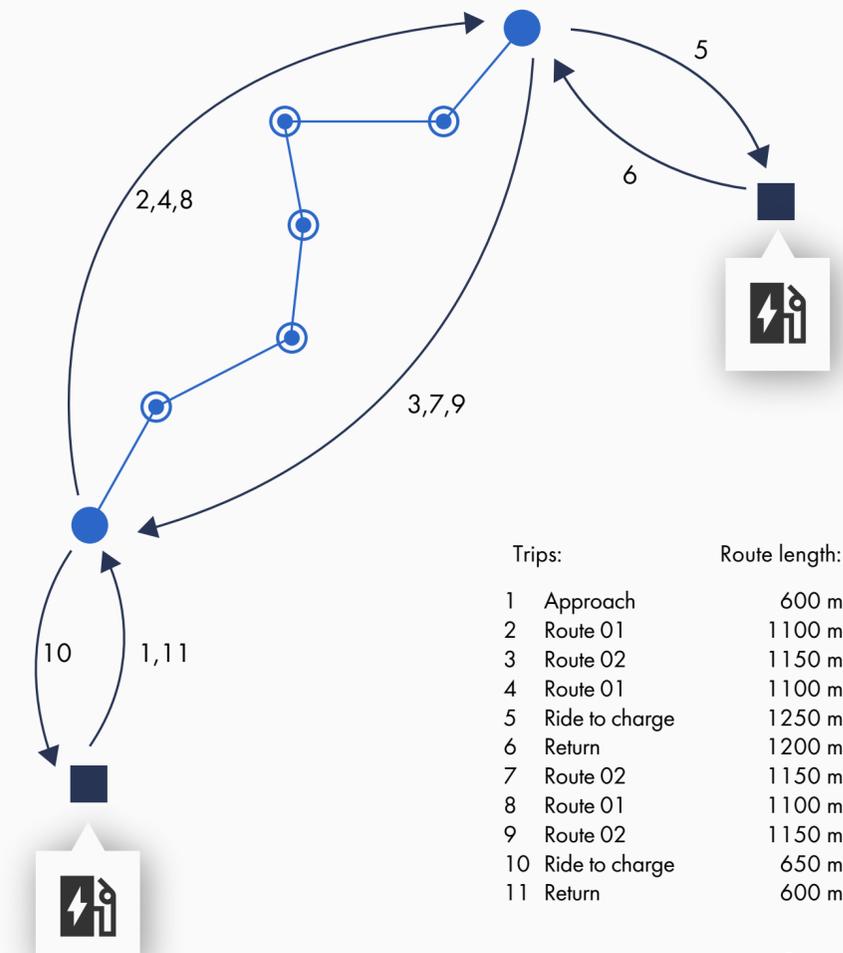


Trips:	Route length:
1 Approach	600 m
2 Route 01	1100 m
3 Route 02	1150 m
4 Route 01	1100 m
5 Ride to charge	1800 m
6 Return	1700 m
7 Route 02	1150 m
8 Route 01	1100 m
9 Route 02	1150 m
10 Ride to charge	650 m
11 Return	600 m

Sum:

**12 100 m**

Example schema 2 - Optimization



Trips:	Route length:
1 Approach	600 m
2 Route 01	1100 m
3 Route 02	1150 m
4 Route 01	1100 m
5 Ride to charge	1250 m
6 Return	1200 m
7 Route 02	1150 m
8 Route 01	1100 m
9 Route 02	1150 m
10 Ride to charge	650 m
11 Return	600 m

Sum:

**11 050 m**

# 2

## Realization



Controlling power level and charging priority in chargers if the power of connected vehicles exceeds the power of chargers.



Checking on an ongoing basis that the vehicle is realizing trip according to the plan and that the course is not at risk due to the possibility of running out of energy.



### TOOLS:

**TELEMETRY**

**MAP AND LINE GRAPH**

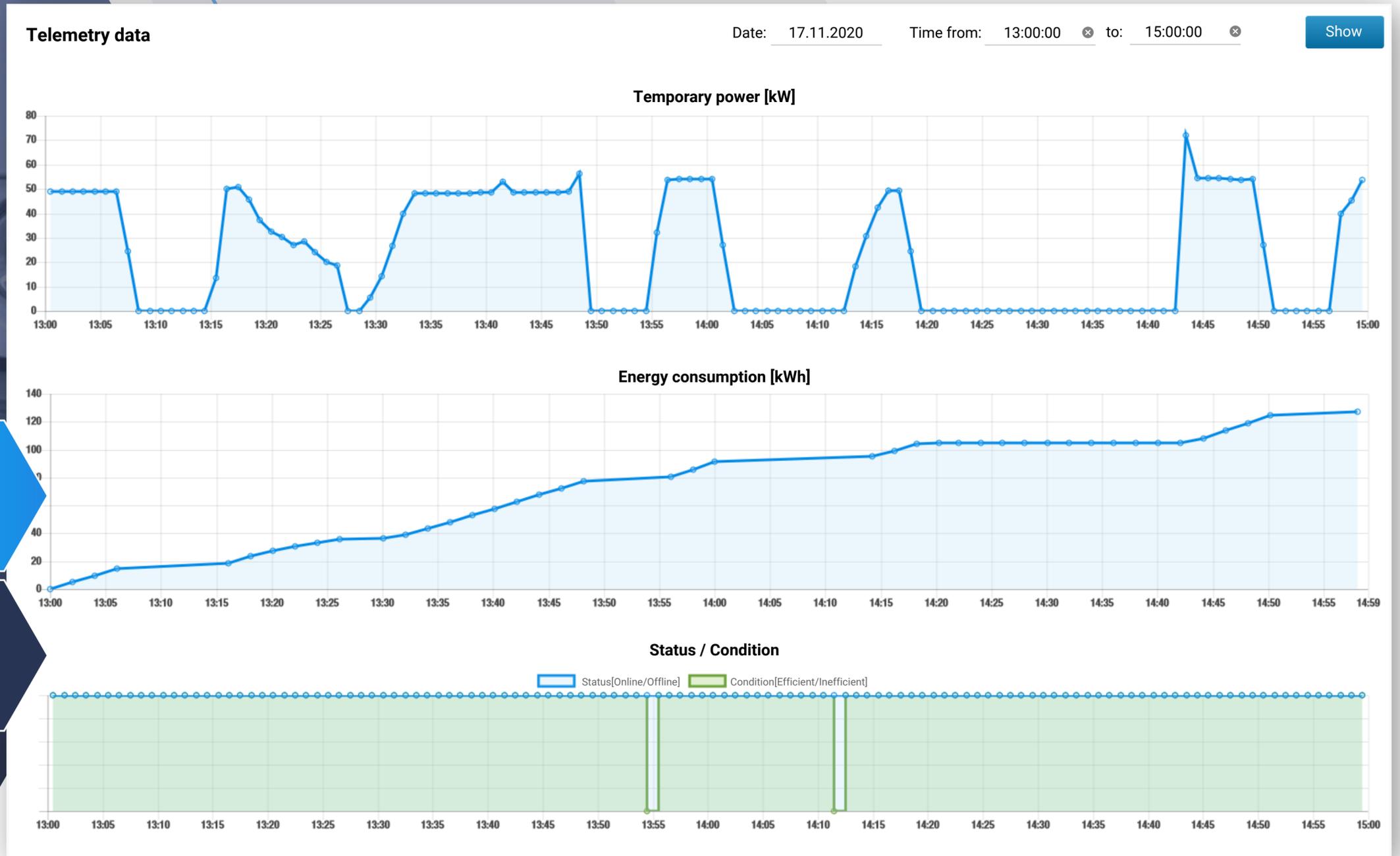
**ALARM SYSTEM**

# 2

# Realization

## Telemetry

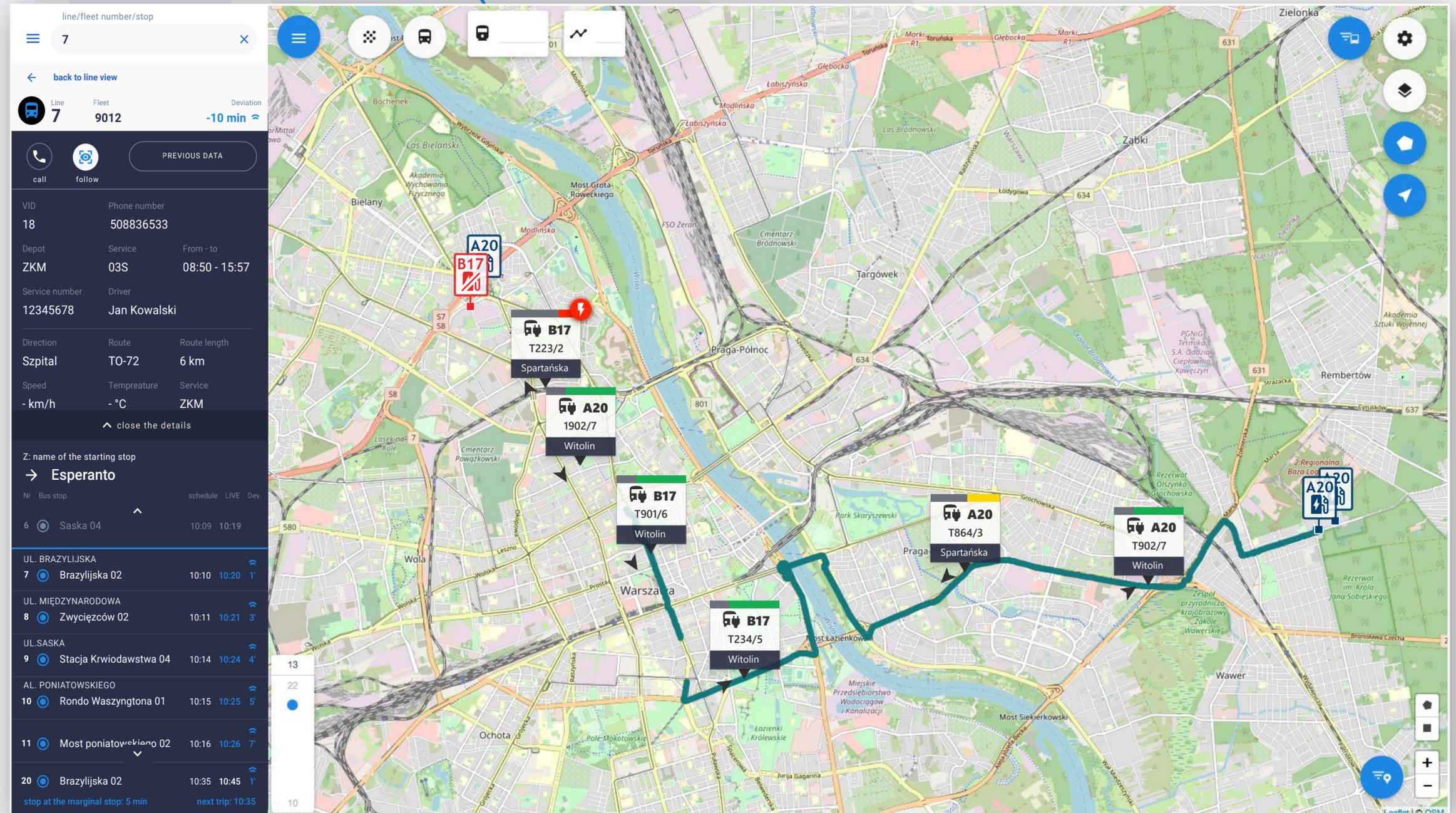
The module allows observation of technical parameters of currently carrying out transport tasks, as well as the analysis of history of signals.



# Realization

## Map and line graph

They allow real-time control of transport tasks and support dispatchers' decisions in case of difficult situations. Both the map and the line graph show the vehicles. The line chart relates the vehicles to the schedule and the currently running transport tasks and illustrates the situation on the line, enables the coordination of activities on the line



# 2

# Realization

## Map and line graph

**Line supervision: 168**

← Back to the lines view

Line/Bigade Fleet number Deviation  
7/3 T012 -1 min

Vehicle service from - to 04:30 - 22:13	Service O-1
Next trip in: 24 min	Speed: 41 km/h
Route length: 15 km	Nearest charger: 18.07 km
Scheduled arrival: 10:29	Estimated arrival: 10:31
State of charge: 51.2%	Range: 58 km
Driver's service from - to 09:30 - 18:47	Driver Jan Kowalski
Driver's service number 12345	

^ Driver's service number

Direction  
→ Szpital

Nr	Stop's number	Schedule	LIVE	In
6	Meissnera 01	10:09	10:19	
7	Bora-Komorowskiego 02	10:10	10:20	1'
8	Umińskiego 02	10:11	10:21	3'

168 222

Schedule:  
168/5 07:09 - 07:18 (in progress)  
168/4 10:02 - 10:21  
222/5 17:09 - 17:40  
168/6 18:09 - 18:37

2/3 2

Witolin Zajezdnia Ostrobramska CH Promenada Zamieniecka Perkuna Bukowskiego Umińskiego Bora-Komorowskiego Meissnera Siekierki-Sanktuarium Male Siekierki Batalionu Ak "Północ" Sielce Iwicka Stepinski

2/3 2

+1 4

-1 3

0 5

-2 2

# 2

# Realization

## Alarm System

Any dangers or irregularities during route are presented in the form of alarms.

Alarms are divided into:



Informational - those that report abnormal situations, however, they are not critical. An example of such an alarm can be too low electric balance of the vehicle. This is interesting information, especially in a broader perspective, but it does not require immediate reaction.



Operational - these are critical alarms that require service. An example of such an alarm for an electric vehicle can be lack of range to reach the nearest charging point.

Electric Alarms (2)		Alarm handling		Confirm		
Alarm type	Line	Brigade	fleet number/Name	Date	Direction/Position	
 No connection to charger	123	-	01/Point 1	12:46 2020-11-18	-	
 No connection to charger	345	-	02/Point 1	09:12 2020-11-18	-	

# 2

# Realization

## Alarm System -operational



Operational alarms cannot be missed, and the system user is not forced to constantly observe technical parameters of the electric fleet in search of possible irregularities.



### CHARGER ERROR

The charger indicates an error if there is no contact with the charger or its available power has been reduced.



### UNREALIZED CHARGING

The vehicle should start charging according to the schedule, which did not happen - no charging according to the schedule.



### LACK OF RANGE

The SOC of the vehicle's battery considering the closest trip and direct route to the charging point is insufficient to reach this point.

# Realization

## EMERGENCIES

Examples of emergency situations are all kinds of failures, independent on the organizer or operator, which are associated with a time deviation from the plan. In such situations, the previously assumed schedule cannot be realized.

At the request of the dispatcher the scheduler generates an ad-hoc emergency schedule, which is supposed to realize the timetable with changed assumptions.

The generated schedule will not include the most optimal solution which is time consuming to prepare by the optimizer, however, it will allow to realize the schedule according to the new assumptions.



FAILURE!



EMERGENCY  
SCHEDULE



SCHEDULE  
REALIZATION



3

# Reports

Save to formats:



TELEMETRY



TRANSPORT REALIZATION



AGGREGATED REPORTS GENERATOR

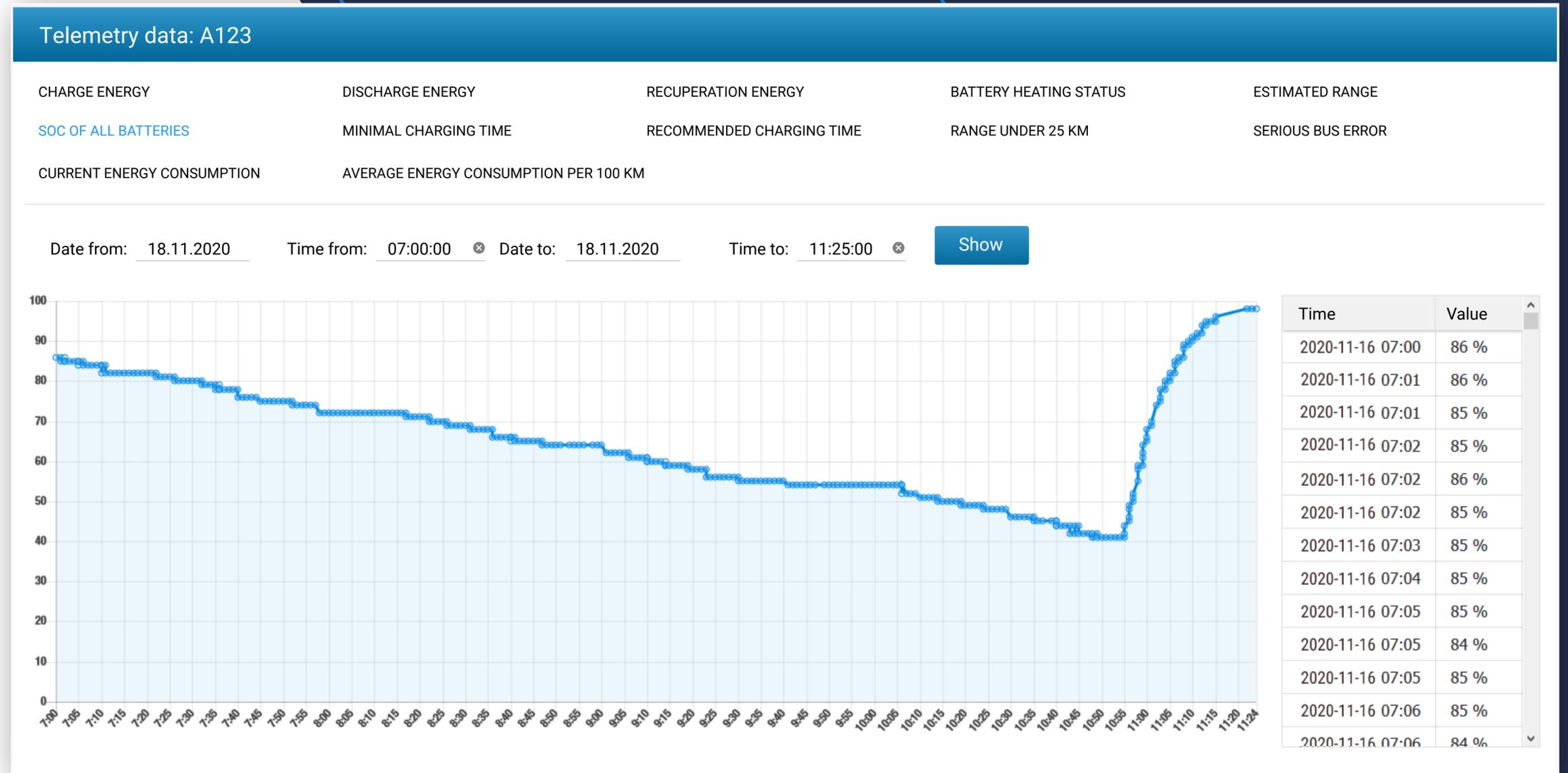


3

# Reports

## Telemetry Reports

Reports allow any combination of telemetry parameters - e.g. battery SOC, average power consumption.



## Telemetry Reports

They allow to relate telemetry parameters to the operation of specific lines - e.g. average energy consumption from 08:00 to 10:00 on line X.

**Electricity consumption report**

Vehicle	Type	Line	Brigade	From	To	Average charged energy	Total charged energy	Average energy used	Total energy used	Average energy of recuperation	Total energy of recuperation
P120	Brand U18E (A)	A21	2	2020-11-16 04:47	2020-11-16 14:26	60.13	191.51	182.08	368.38	45.21	104.47
P123	Brand U18E (A)	A21	9	2020-11-16 00:00	2020-11-16 14:26	82.93	308.14	156.94	510.25	50.37	176.99
P123	Brand U18E (A)	A21	12	2020-11-16 06:09	2020-11-16 14:26	39.57	127.42	112.36	243.11	34.39	77.31
P127	Brand U18E (A)	A21	3	2020-11-16 06:25	2020-11-16 14:26	33.56	93.09	88.38	208.40	27.03	68.23
P120	Brand U18E (A)	A21	5	2020-11-16 06:47	2020-11-16 14:26	22.90	63.98	48.73	135.19	15.97	46.49
P121	Brand U18E (A)	A21	014	2020-11-16 00:00	2020-11-16 00:11	131.81	0.00	258.42	0.18	85.10	0.00
P124	Brand U18E (A)	A21	7	2020-11-16 04:23	2020-11-16 13:55	33.86	91.28	98.87	268.61	28.72	84.10
P125	Brand U18E (A)	A21	11	2020-11-16 04:10	2020-11-16 14:26	52.42	116.60	115.54	271.19	31.80	80.16
P128	Brand U18E (A)	A21	1	2020-11-16 04:21	2020-11-16 14:26	49.90	147.93	124.77	277.42	38.67	94.64
P180	Brand U18E (A)	A21	014	2020-11-16 13:59	2020-11-16 14:26	8.92	0.00	115.14	5.33	38.54	0.49
P280	Brand U18E (A)	A21	8	2020-11-16 06:31	2020-11-16 14:26	41.52	111.18	103.49	228.52	33.17	77.76
P233	Brand U18E (A)	A21	1	2020-11-16 00:00	2020-11-16 00:01	313.36	1.26	666.40	0.00	171.34	0.00
P236	Brand U18E (A)	A21	7	2020-11-16 13:24	2020-11-16 13:31	1.26	4.08	6.03	7.75	0.00	0.00
P238	Brand U18E (A)	A21	8	2020-11-16 03:14	2020-11-16 08:23	0.01	1.27	43.17	118.27	10.69	32.18
P250	Brand U18E (A)	A21	10	2020-11-16 06:41	2020-11-16 14:25	31.08	85.76	81.76	185.20	22.62	53.62
P252	Brand U18E (A)	A21	10	2020-11-16 00:00	2020-11-16 00:15	254.57	14.54	438.16	0.00	137.57	0.00
P253	Brand U18E (A)	A21	4	2020-11-16 04:12	2020-11-16 14:26	52.70	132.18	129.88	288.13	34.30	85.36

# 3

# Reports

## Aggregated reports generator

Reports can be run according to a schedule. The user can enter his own report templates. Generator allows the user to prepare any collations. The operation of the generator is based on early preparation of data for aggregation in a daily cycle, and then generating reports based on previously prepared. According to its construction, the generator can create aggregated reports with the use of statistical function from very large data periods.

An example of a report might be average, minimum, maximum, standard deviation, median battery consumption by battery type and line in monthly comparison.

The screenshot displays the 'Reports Generator Module' interface. It features a sidebar with navigation options: 'Desktop', 'Reports Generator', and 'Warehouses'. The main content area is divided into three sections:

- Yours reports (7):** A search bar 'Search by name' is at the top. Below it are seven report cards, each with a creation date, title, and icons for deletion and sharing. The reports include: 'Average, Minimum, Maximum Standard Deviation' (Created 10-01-2020), 'Annual Statement - Median' (Created 11-02-2020), 'Quarterly Statement - Median' (Created 11-02-2020), 'Battery Consumption' (Created 18-02-2020), 'Data from vehicle' (Created 24-03-2020), 'Charging' (Created 10-05-2020), and an empty card (Created 12-05-2020).
- Reports shared by others (3):** Three report cards shared by other users, including 'Average, Minimum, Maximum Standard Deviation' (Created 01-01-2020 By User Name), 'Battery Consumption' (Created 12-05-2020 By User Name), and an empty card (Created 12-05-2020 By User Name).
- Warehouses (2):** Two report cards, including one updated on 19-11-2020 at 17:08 and another titled 'Test' updated 50%.



**Thank you for  
your attention.**

**We invite you  
to cooperation!**