



KRUCH

RAILWAY INNOVATIONS

Making a difference

Applying digital solutions
with effect



ENERGY



25% of CO₂ emissions
in EU road-transport

is produced by buses,
coaches and lorries

will increase +10% until 2030



buildings consume
worldwide

40% of the energy

160 Billion € HVAC costs/year

(8 €/m² average/year)

US Green Building Council



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This is me

- Jan Röhl
- 1977
- 3 kids
- 1 wife
- 1 Mission: *„Cut the energy consumption of public transport and buildings*
by at least 20%
without reducing
performance and comfort”

*building a network
of specialists and partners*

*to create immediately
applicable, effective tools*

- Electrification of transport networks
- Energy Flow Simulations of transport systems
- Internet of „everything“ - loX
- digital twinning of inventory
- Intelligent use of energy in buildings

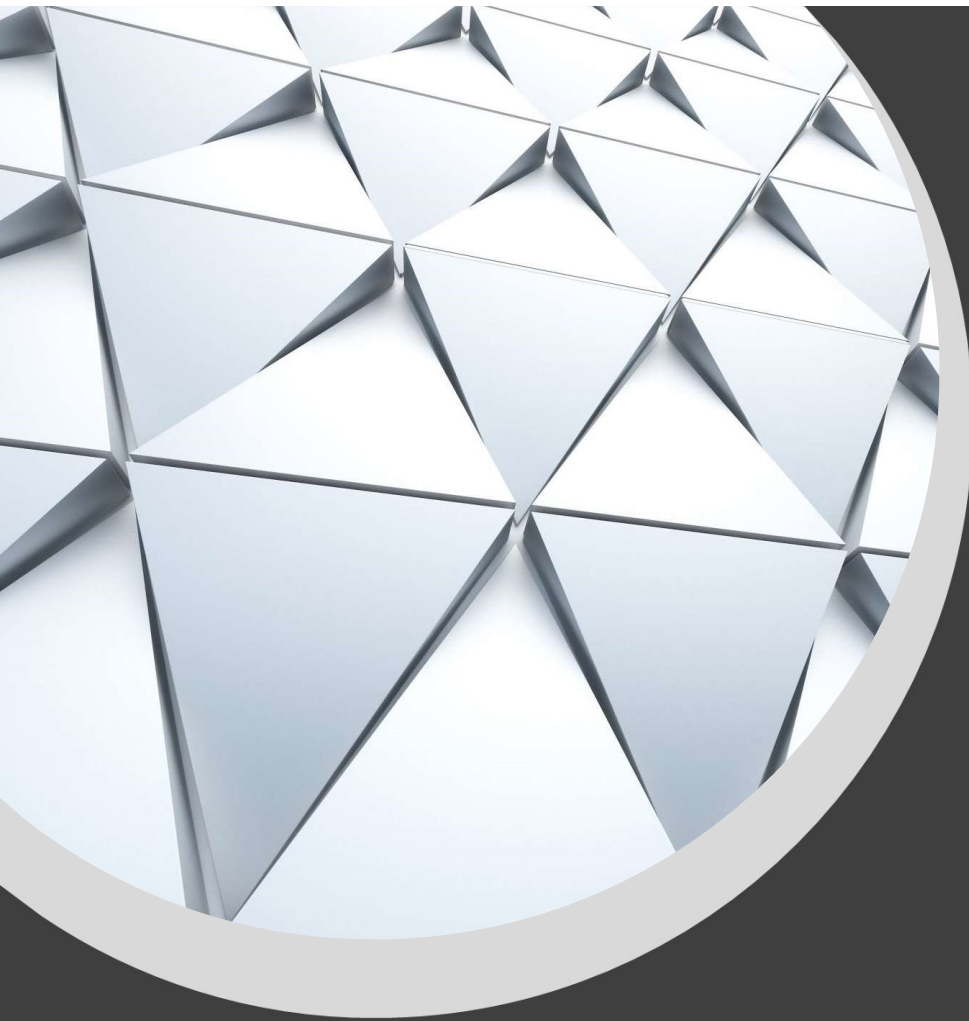
ME30X



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TeDaLoS™

KRUCH
RAILWAY INNOVATIONS



If...

you knew everything (in real time) about your...

- network, electrical system, rolling stock
- Pass. volume, weather, traffic situation, ...

and you could compute all this information (in real time)

- Cloud computing
- AI, machine learning

and you could influence every parameter (in real time)

- moving patterns/acceleration, electrical settings/power supply
- time schedule/vehicle plan, predictive maintenance

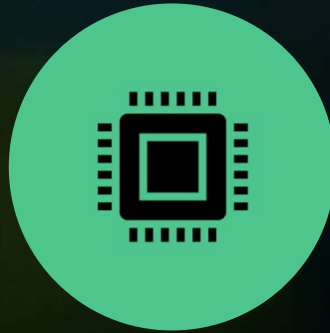
...what amazing benefits could you utilize?!

We combine...



BIG DATA

SENSORS, WWW-PLATFORMS, SIMULATION
RESULTS



ARTIFICIAL INTELLIGENCE

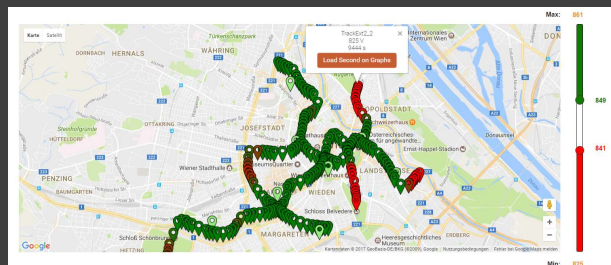
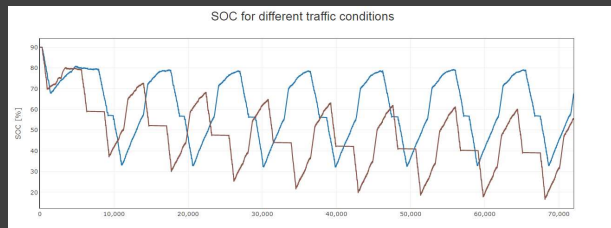
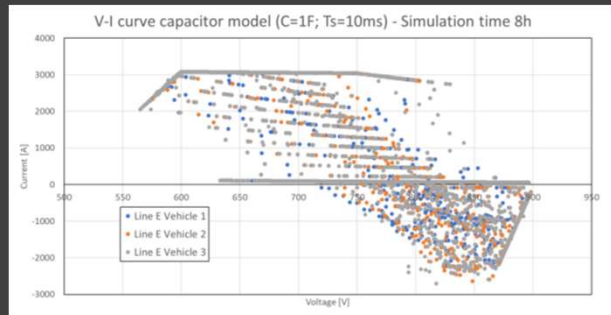
MACHINE LEARNING ALGORITHMS



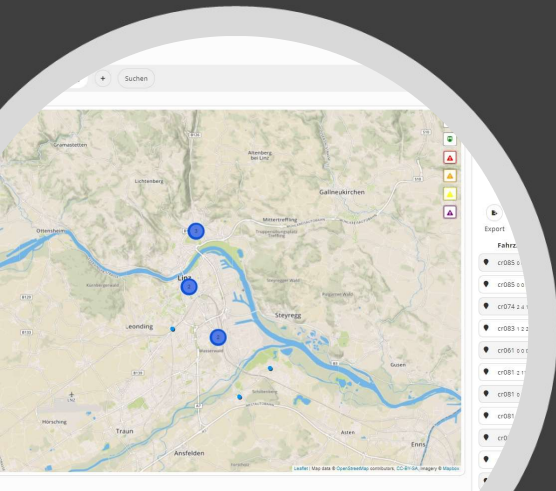
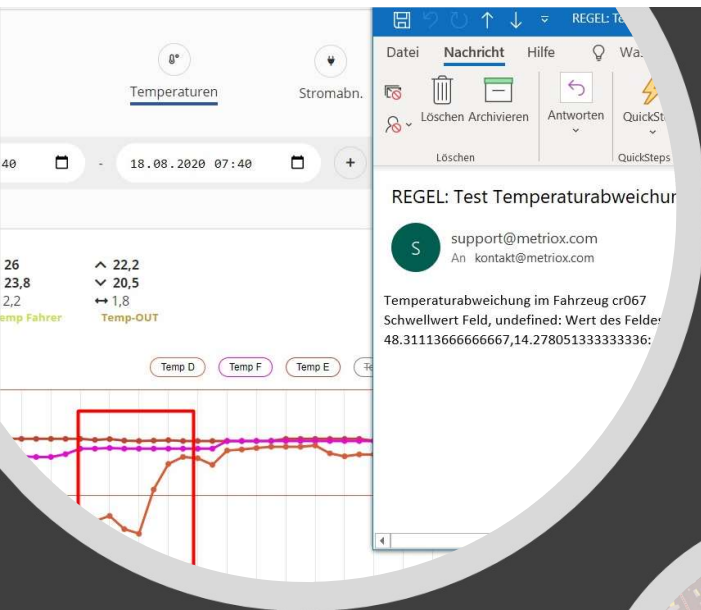
TAKE ACTION

DRIVERS, MECHANICS, ENGINEERS,
ACTUATORS

EFS - Energy Flow Simulation



- every current
- on each meter
- in every second
- „*most complex simulations - playfully easy*“
- electrical limits // timetable feasibility
- substation overloads // n-1 situation
- voltage on contact wire // short-circuits
- SOC // in-motion-charging // charging points
- electromagnetic fields // thermal limits
- Middle voltage network



FLATA - fleet data

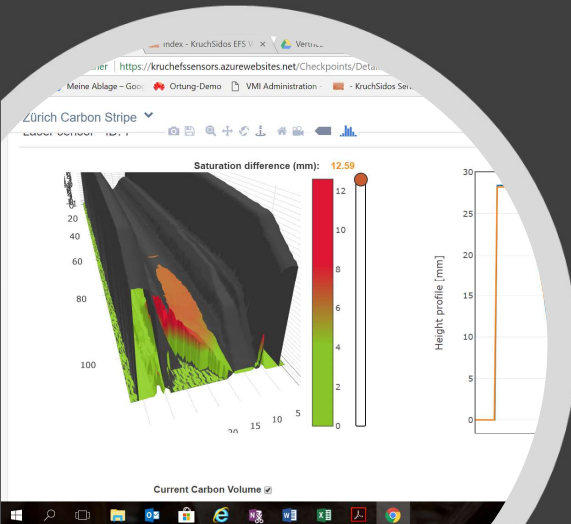
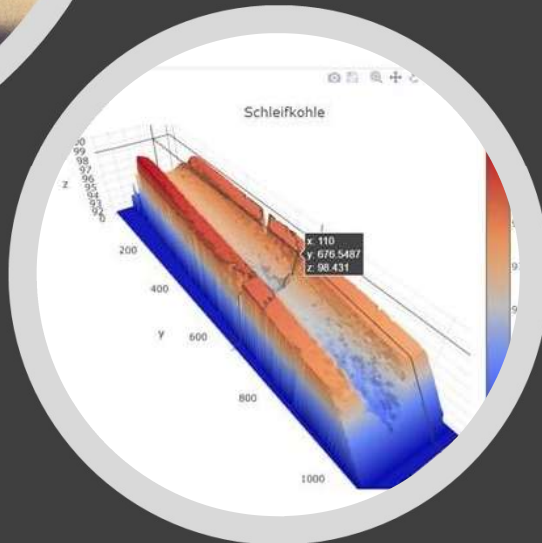
- from each vehicle
- GPS-position, condition (failure codes), activity, temperatures, voltage, ...
- in every second
- „*your fleet on your screen*“
- preventive maintenance // immediate action
- analyze accumulation of events
- continuous monitoring of fleet and network

Trolley-Checkpoint

- for every bus
- 3D-laser scan
- contact force check

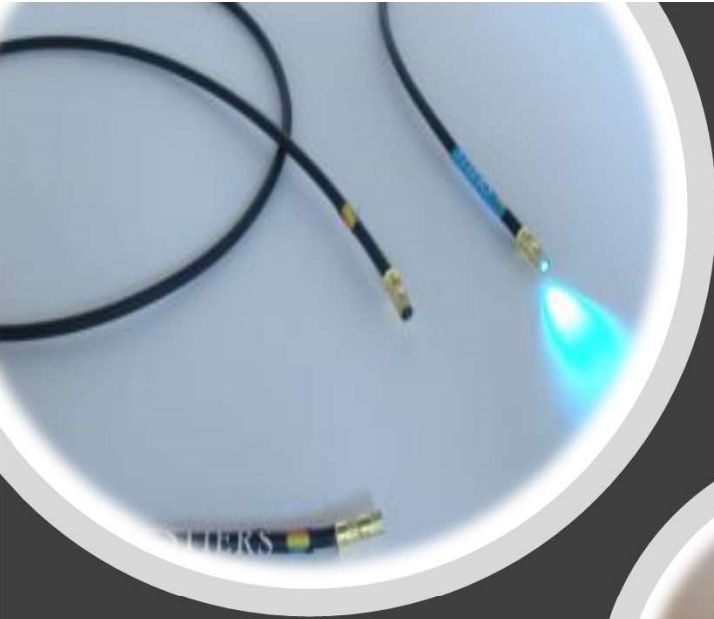
- ***“automatic check of current collectors”***

- carbon replacement in the right moment
- tremendous reduction in labor
- less wear on contact line
- monitoring of contact line

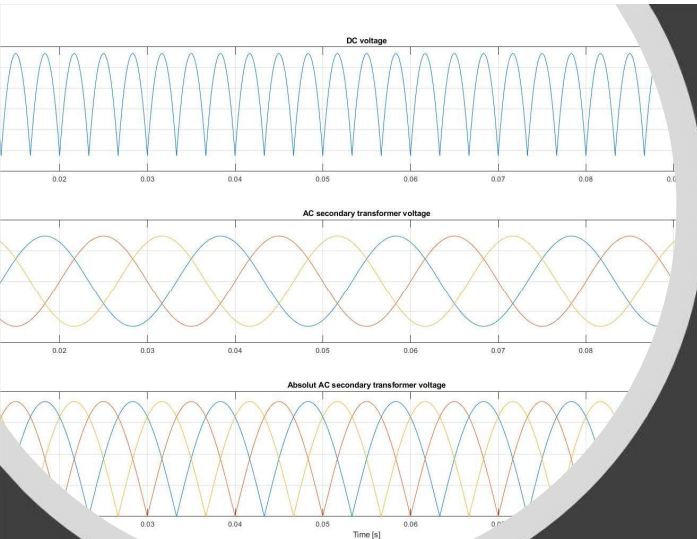


NETDATA – network data

- cw-uplift-sensor
- cw-temperatur sensor
- ***“your sensors on the contact line”***
 - detect failures in contact line
 - detect failures of pantographs
 - detect ice, fallen trees, ...



SUBDATA – Substation Data (in development)



- U / I
- each transformer // feeding line
- in every second
- ***“all substations at a glance”***
- remote condition monitoring
- immediate / preventive action
- monitoring of your network

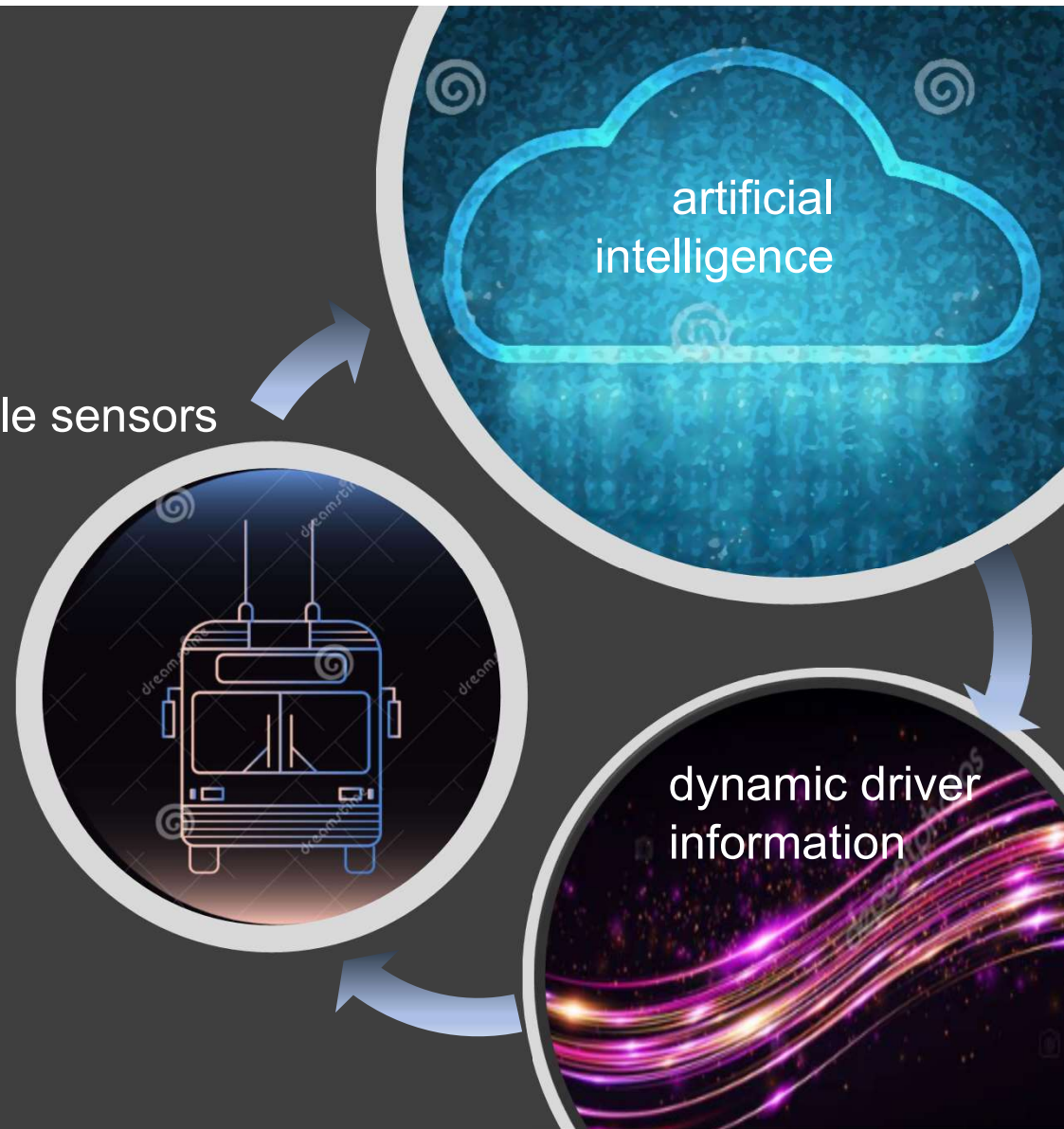
Eco Surfer (in development)

- vehicle data & position
- contact line voltage
- recovered energy
- ***“surfing on energy waves”***
 - use braking energy for traction
 - no energy burnt on braking resistors
 - => big energy savings

vehicle sensors

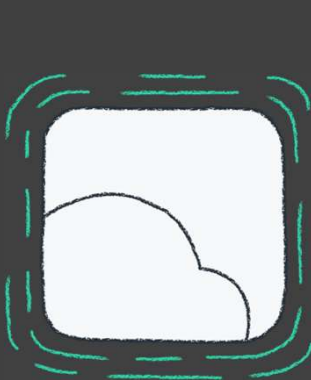
artificial
intelligence

dynamic driver
information

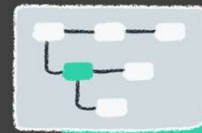


automatic energy optimization for HVAC

customized
sensors



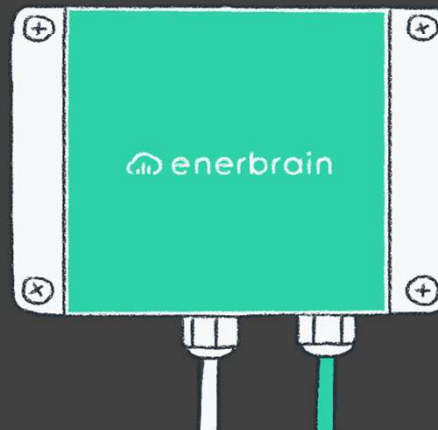
artificial
intelligence



intuitive
dashboards



dynamic
automation



„reduction of HVAC energy consumption 15-35% without reducing comfort“



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Digital solutions – with effect

- EFS – Energy flow Simulation
- FLATA – Fleet Data, Monitoring
- Trolleybus Checkpoint – daily automatic check
- NETDATA – Catenary Sensors, Monitoring
- SUBDATA – Substation Data, Monitoring
- ECO SURFER – intelligent use of traction energy
- ENERBRAIN - Intelligent use of energy in buildings



20% potential in savings
(energy, LCC)



without reducing
performance or comfort



by using latest
technologies (BIG DATA,
AI, real-time-control)

Let's make a difference!

Please contact:

- Jan Röhl
- owner
- Mobile: +43 699 5267645
- Phone: +43 1 616 31 65
- E-mail: jan.roehl@kruch.at
- Web: www.kruch.com
- KRUCH Railway Innovations GmbH & Co.KG
- Pfarrgasse 87, 1230 Vienna - Austria

