



Rail2Grid



Turning Trains Into PowerStations!

Widespread electrification of the transportation sector and the vastly increased need for energy storage are transforming energy as we know it. It's Time to Decarbonize Our Rail Industry!

Overview

Power distribution networks and rail networks both share a common dilemma. They have both been developed independently and so can only rely on the resilience and capability of their own existing infrastructure when meeting the power demands placed upon them. This presents huge challenges when attempting to add Renewable Energy Sources (RES) and Electric Vehicle (EV) chargers to the network to decarbonise electric supply and transportation.

As difficult as this might be, by implementing TPS ultra-efficient **Rail2Grid** management system consumers can greatly improve their energy performance and consumption while lowering Heat and CO₂ emissions. This in return tremendously benefits our environment and reduces operating costs.

TPS innovative **Rail2Grid** management system offers:

- Smart Connectivity through facilitation of power exchange between both networks and connected devices.
- Reduction of system losses that would otherwise be lost as heat.
- Greater network resilience and stability in a high RES and/or EV charger penetration scenario.
- Commercial opportunities for other stakeholders such as energy retailers and EV charge point operators.

This product presents an economically viable and easily replicable electric Transport-Grid Inter-Connection System that will establish synergies between the power distribution networks, electrified transport networks (metro, trams, light railways etc.) and on-site charging stations for EV.ⁱ

Challenges

The power demand of electric railways is constantly changing as it varies due to rail traffic density on the lines and passenger volumes. As the power supply for railways comes from several substations across the railway lines, the load is shifted from place to place when trains are travelling, leading to a redistribution of the power flows of the distribution network and, hence, poor voltage regulation leading to significant power losses.ⁱⁱ The problem is exacerbated when adding (RES) as they require additional converter designs to condition the photovoltaics output.



Solutions

TPS ultra-efficient **Rail2Grid** management system will reduce electric losses in both networks, maximize the use of local Renewable Energy Source generators for both applications making them interact with one another in a mutual synergy strategy. This is accomplished by introducing three power electronics converters designed by our highly skilled engineering team which are based on the latest technology utilising Silicon Carbide semiconductor switches. Operating these devices at such high switching frequencies (>20,000 Hz) enables a highly efficient, compact and near silent power transfer solution.




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Low Voltage Grid Tied Inverter (LV-GTI) to condition and transfer the energy from the Rail network and the Battery Energy Storage System (BESS) network to the low voltage (LV) grid *or* to transfer energy from the low voltage grid into the BESS.


Rail Converter (RC) to condition and transfer the train's braking energy from the Rail network to the LV grid and/or the BESS.


Energy Storage System Converter (ESSC) to condition and transfer the energy from the Rail network or LV grid and store it in the BESS.


Benefits


Recovery of otherwise wasted energy from trains during braking operation. 

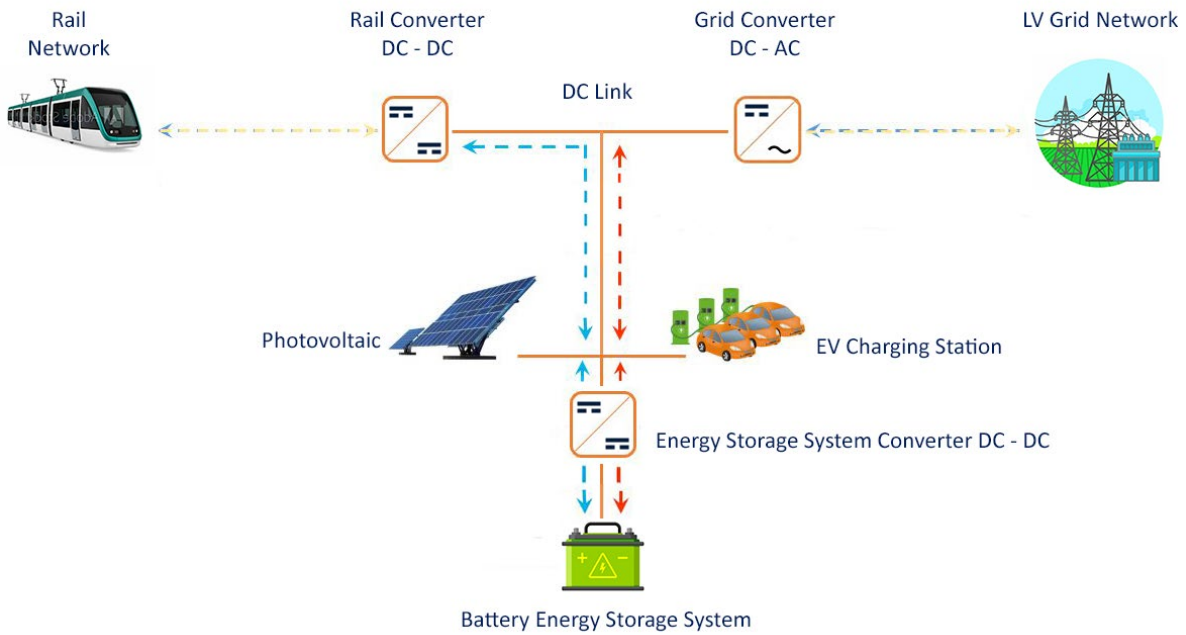
Reduced voltage drops between rail sub stations leading to lower power losses. 

Improved Grid supply power quality and available capacity. 

Link new energy actors such as prosumers, EVs and electric storages. 

Reducing Trains weight by eliminating rheostatic converters and resistors leading to further energy saving. 

Provide energy and transportation supply with lower CO₂ emissions. 



	Rail Converter (RC) DC-DC	Energy Storage System Converter (ESSC) DC-DC	Low Voltage Grid Tied Inverter (LV-GTI) DC-AC + Grid Isolation
<i>Input Voltage</i>	670Vdc to 750Vdc	775Vdc	400Vrms, pH-pH +/- 10%
<i>Output Voltage</i>	775Vdc	600Vdc to 750Vdc	775Vdc
<i>Standard</i>	IEC 62477-1	IEC 62477-1	IEC 62477-1
<i>Rated Power</i>	200kW	200kW	80kVA
<i>Protection</i>	Over-Current. Over/Under Voltage. Over Temperature. Loss of Control Power Supply	Same as DC-DC Rail Converter	Same as DC-DC Rail Converter + Over/Under Frequency
<i>Cooling</i>	Forced Air Cooling	Forced Air Cooling	Forced Air Cooling
<i>Mass</i>	650Kg	270Kg	600Kg
<i>Dimensions (mm)</i>	1200 (W) 600 (D) 2100 (H)	800 (W) 600 (D) 1900 (H)	850 (W) 850 (D) 1900 (H)
<i>Direction</i>	Uni-Directional	Bi-Directional	Bi-Directional

About E-LOBSTER

The Rail2Grid is part of E-LOBSTER project. The name stands for “**E**lectric **L**osses **B**alancing through integrated **S**torage and power **E**lectronics towards increased synergy between **R**ailways and electricity distribution networks”. Within this consortium, TPS are collaborating with Newcastle University and 7 other members: RINA, Rail Safety and Standards Board (RSSB), The University of Birmingham, Lithium Balance, Metro de Madrid, Spanish Railways Foundation (FFE) and The International Association of Public Transport (UITP).

About TPS

Turbo Power Systems (TPS) is a leading CleanTech company that offers innovative solutions to enable an accelerated path to a greener and net zero future for its global customers. TPS’s innovative solutions are based on two broad technology areas namely, compact high-speed permanent magnet machines with active magnetic bearings and ultra-efficient power electronics. TPS’s products are currently deployed in various applications including but not limited to power distribution grid reinforcement, electric mobility charging, railway passenger comfort and battery charging, wastewater aeration blowers, industrial air-conditioning, and refrigeration and gas transportation. TPS is headquartered in Gateshead, UK and operates globally through our sales offices in Brazil and the USA. In addition, TPS also has well-established partners in Malaysia and India.



References

ⁱ e-lobster.eu, (2019). Project brief. Available: <https://www.e-lobster.eu/project-brief/>, [Accessed 18/08/2021]

ⁱⁱ Innovation and Networks Executive Agency, EUROPEAN COMMISSION, (2019). E-lobster, P.3.

