

## **Alternative Energy for Transport: Present and Future**

### **KEY CONCLUSIONS**

#### **Russian Railway's fuel expenditures are growing**

"Russian Railways spends 300 billion roubles a year on fuel and energy resources. The share of the budget on fuel and energy resources is growing persistently since the start of 2018. According to the economy department, it will make up 19.9% of the budget this year," Boris Ivanov, Deputy Head, Department of Technical Policy, Russian Railways.

#### **Russian Railways is aiming to reduce its consumption of diesel fuel**

"The company (Russian Railways) set a goal to substitute 25% of diesel fuel used by locomotives by 2030 <...> This is a government objective <...> in accordance with the instructions of the President of the Russian Federation," Igor Sazonov, Chief Designer, Scientific Research and Design Technology Institute of Rolling Stock JSC.

### **PROBLEMS**

#### **Insufficient traction power system**

"A large portion of the bottlenecks are tied to the traction power system," Vladislav Nezevak, Researcher, Omsk State Technical University.

#### **Lack of standards for implementing new technologies**

"Currently, there are practically no standards related to using hydrogen technology in Russia or abroad," Andrey Zarucheyevskiy, Head of Department Traction Rolling Stock, Railway Research Institute.

#### **Diesel locomotives must be rebuilt for new types of fuel**

"If any alternative types of fuel can be proposed as a replacement for diesel fuel, but without any significant reconstruction of diesel locomotives, we would be happy to consider them," Boris Ivanov, Deputy Head, Department of Technical Policy, Russian Railways.

### **SOLUTIONS**

### **Using hybrid and battery-powered locomotives**

"Hybrid and battery-powered locomotives are more cost-effective compared to the traditional version. At the same time, the initial cost of the car is 2–3 times more expensive, so the savings only occur within the car's lifespan <...> Hybrid cars are 27% more cost-effective than traditional cars, while battery-powered <...> are a 30% improvement," Igor Sazonov, Chief Designer, Scientific Research and Design Technology Institute of Rolling Stock JSC.

"We expect to first see a hybrid locomotive, and then a battery-powered one right after. The hybrid version [is] close to its commercial stage, while the first working versions of battery-powered locomotives should appear in Russia in 2019–2021 <...> which might significantly affect the future structure of traction transport in Russian Railways," Igor Sazonov, Chief Designer, Scientific Research and Design Technology Institute of Rolling Stock JSC.

"If we add a battery to a traction power system, it has to be sufficiently powerful to store the excess electrical energy and work intermittently, because the breaking period lasts for less than two and a half minutes <...> Research has shown that batteries are more effective when used at <...> feeder pillars," Vladislav Nezevak, Researcher, Omsk State Technical University.

### **Using liquified natural gas as fuel**

"There is a specific preference for using liquified natural gas, since more of it can be stored on board a locomotive. <...> A development prototype of a KT1H001 gas turbine locomotive with a gas power turbine <...> It has already run for 2640 motor hours, and there are practically no issues to report regarding the gas power turbine. <...> These positive results allowed us to make the decision to build a second prototype <...> which received a certificate of conformity in 2016 and is now commercially employed <...> These locomotives are environmentally clean. They produce the most dangerous type of emission – nitrogen oxides – at under half the level established by EU directives," Igor Sazonov, Chief Designer, Scientific Research and Design Technology Institute of Rolling Stock JSC.

### **Creating fuel cells units**

"A decision was made <...> to protect the environment and labour, to create a fuel cell unit for use in tunnels <...> This is a classic example of serial hybrids, or fuel cells which are powered by hydrogen and oxygen <...> This is Russian Railway's first experiment that has shown that this technology <...> can be functional <...> and we've solved the issue of industrial safety <...> We had to <...> receive approval to operate. This allows us to implement further experiments in hydrogen energy," Andrey Zarucheykiy, Head of Department Traction Rolling Stock, Railway Research Institute.

### **Using heat pumps**

"The technologies already making their way into the Russian market are saltwater-water and water-water heat pumps <...> The Russian market is fairly cautious about using air source heat pumps, since many of the country's regions have a cold climate," Sergey Solovyev, Development Engineer Renewable Energy and Energy Efficient Technologies, Viessmann LLC.

### **Using synthetic diesel fuel**

"Methanol <...> is being used as an additive in motor fuel <...> synthetic diesel fuel is a methanol analogue. Its advantage lies in the fact that <...> it has a lower freezing temperature <...> and is considered a clean product. <...> Both synthetic diesel fuel and synthetic motor oil are produced," Vladimir Kiriachek, Director, New Technologies LLC.