



## Fuel options for greening public transport compared

**A recent assessment** of fuels used in public transport in Kaunas, Lithuania, has found that buses powered with locally-produced biogas and trolleybuses powered with electricity generated from natural gas cause the least environmental damage for the city.

**Most National Strategic Reference Frameworks** submitted by EU Member States indicate that sustainable urban transport needs to be addressed. To help planners across Europe modernise public transport and reduce the use of private cars, this study compared the energy requirements and environmental impacts of using modern buses and trolleybuses powered by different fuels using a life cycle analysis (LCA) method. Environmental impacts considered were effects on human health, ecosystems and resources.

The life cycle impacts of the fuel chain from extraction, transportation, production, distribution and use ('well-to-wheel') were compared for diesel-powered buses, compressed natural gas buses, compressed biogas (locally sourced) buses and trolleybuses powered by electricity generated from natural gas or heavy fuel oil. The analysis was applied to the city of Kaunas where public transportation accounts for 60% of overall transportation in the city.

Over the entire fuel chain and among the options studied, compressed biogas powered buses caused the least environmental damage. This is because it is sourced locally from a wastewater treatment plant, minimising resource extraction impacts associated with non-renewable resources, such as oil and natural gas. Based on 1 km of travel by bus or trolleybus, the consumption of energy associated with the 'well-to-pump' stage of the fuel chain (extraction through to distribution) was the highest for compressed natural gas buses, followed by diesel for buses, natural gas for electricity generation for trolleybuses and heavy fuel oil for electricity generation for trolleybuses. In comparison, compressed biogas for buses comes from a renewable source of energy, which produces natural resource benefit.

Fuel consumption varied among the types of buses and trolleybuses, depending on its source and how it was combusted. For example, compressed biogas buses consumed the most fuel (although emissions are of biological origin) and the lowest consumption was in trolleybuses using electricity generated from natural gas. Using natural gas to produce electricity for trolleybuses was almost twice as energy-efficient as using natural gas to directly power the buses.

Electricity generated from heavy fuel oil or from natural gas for use in trolleybuses caused the least environmental damage when compared with fuel derived from diesel and compressed natural gas for use in buses or trolleybuses. Compressed biogas, a renewable source of energy produced locally from wastewater sludge, had the lowest damage to resource impacts when used in buses.

Other results of the study suggest:

- Although emissions from compressed natural gas buses and compressed biogas buses are similar, higher levels of carbon dioxide are emitted from compressed biogas buses (although of biological origin) than from compressed natural gas buses
- The greatest damage to human health came from high levels of particulates, nitrogen oxides and carbon monoxide emitted from diesel buses
- Emissions of greenhouse gases from buses powered by compressed natural gas caused the most damage to ecosystems.

The researchers suggest that LCA is a useful method for public transport planning in urban areas, but that it needs to be adapted to the characteristics of each city or town.

1. [http://ec.europa.eu/regional\\_policy/glossary/national\\_strategic\\_reference\\_framework\\_en.htm](http://ec.europa.eu/regional_policy/glossary/national_strategic_reference_framework_en.htm)

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